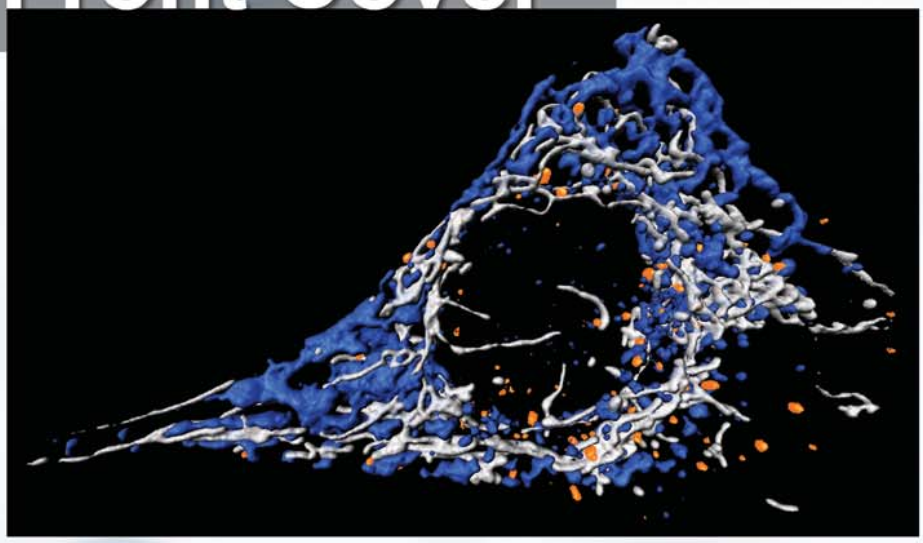
CSIR-IICB

सी एस आई आर
भारतीय रासायनिक जीवविज्ञान संस्थान

CSIR-Indian Institute
of Chemical Biology

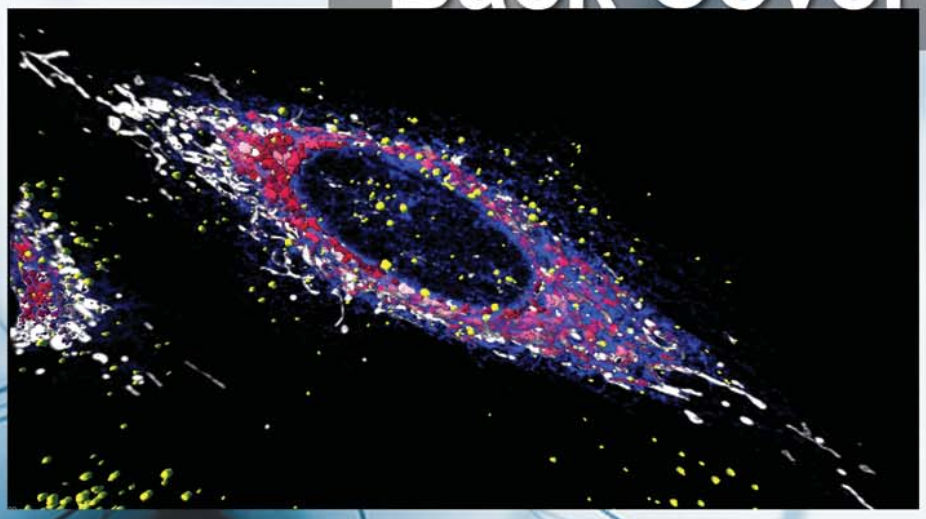
वार्षिक प्रतिवेदन
Annual Report 2016-17

Front Cover



Confocal microscopy of WISP3-myc transfected chondrocyte line depicts co-localization (yellow) of mitochondria (mitotracker green FM: green) with WISP3-myc (red).

Back Cover



Confocal microscopy depicts mitochondrial Ca2+ uptake estimated by co-localization (yellow) of Ca2+ (Rhod2: red) with mitochondria (Mitotracker green FM: green) in a WISP3 depleted chondrocyte line.

Courtesy : Dr. Suvendra Nath Bhattacharya

Jadavpur Campus

Salt Lake Campus

वार्षिक प्रतिवेदन
Annual Report
2016-17

सी एस आई आर भारतीय रासायनिक जीवविज्ञान संस्थान

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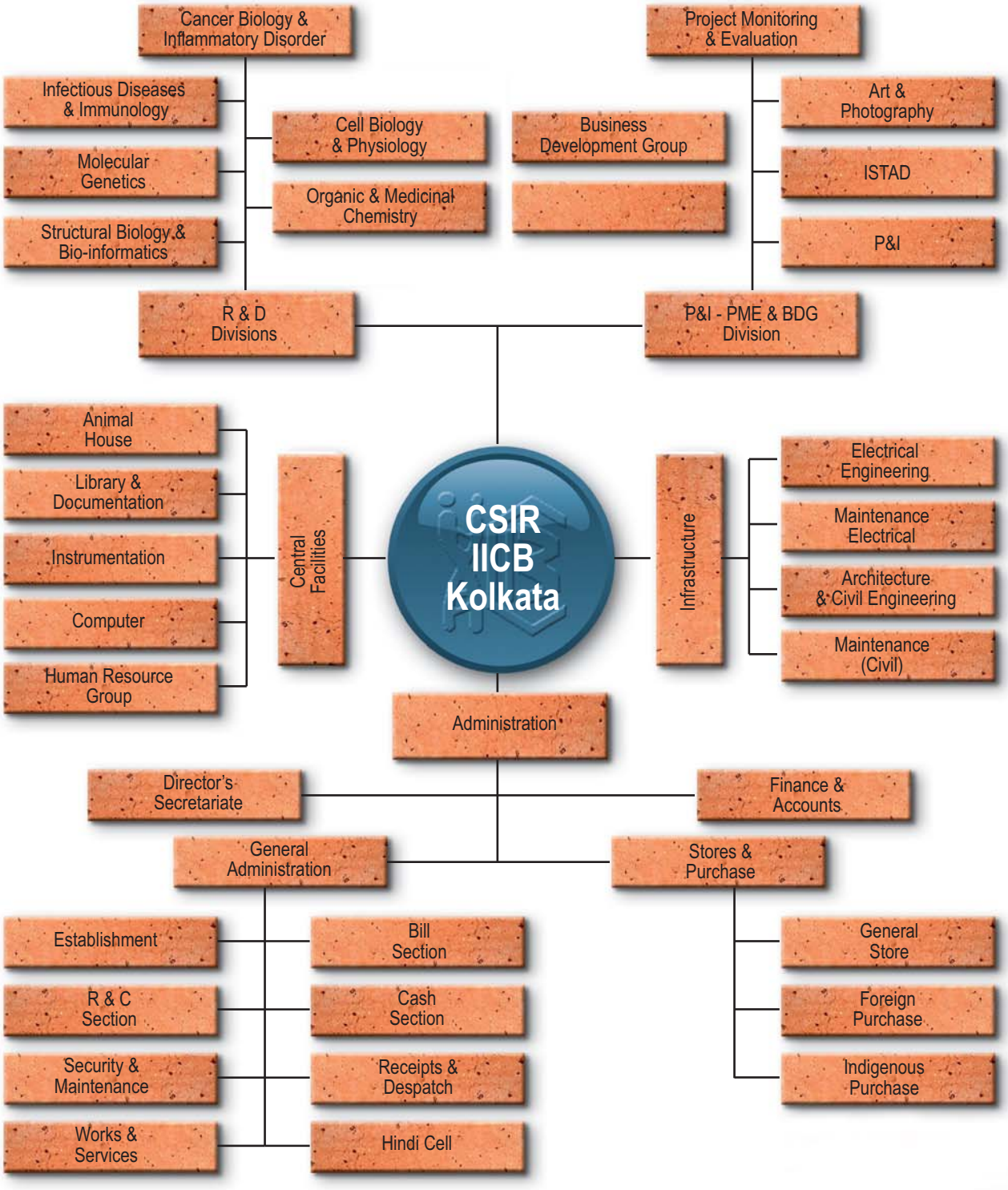
Cancer Biology & Inflammatory Disorder
Infectious Diseases & Immunology
Molecular Genetics
Structural Biology & Bio-informatics
Cell Biology & Physiology
Organic & Medicinal Chemistry
R & D Divisions
Project Monitoring & Evaluation
Business Development Group
Art & Photography
ISTAD
P&I
P&I - PME & BDG Division
Animal House
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Establishment
R & C Section
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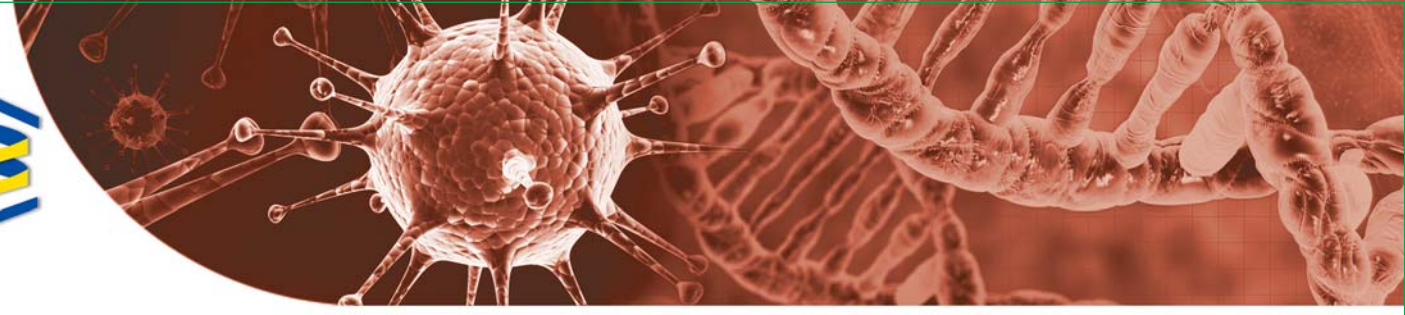
Director's Report

It is my proud privilege to present the Annual Report which assembles the major activities of this Institute for the period from April 2016 to March 2017. This report is an indication of our growth and a document of our accountability. Every year the Institute publishes its Annual Report to disseminate a brief description of our research activities to our friends, well wishers and scientific communities across the globe. Apart from the scientific contributions, this report also includes significant information about our infrastructure, extramural funding, publication, intellectual property and other various aspects of scientific management and administration.

The institute embodies a symbiosis between chemistry and biology that translates to a commitment to advance affordable healthcare for all. While biologists are constantly working on comprehending physiological processes and diseases, chemists are tirelessly making tools to harness and redefine biological phenomena. The progress of CSIR-IICB essentially depends on its R&D activities and like preceding years the institute continued its growth through quality research on diseases of national importance and biological problems of global interest, employing sophisticated state-of-the-art technology in keeping with the rapid and unprecedented momentum that life science research has gained globally over the last five decades. CSIR-IICB Infrastructure continues to be upgraded. In order to strengthen the basic research and to attain translational objectives, a second campus with a four storey building was constructed at Salt Lake, Kolkata which is operational. The unit is named CSIR-IICB Translational Research Unit of Excellence (TRUE). This new unit has objective for research facilitation by establishing advanced technological platforms, establishing a Biomedical Incubation Center for MSMEs, start-up companies and translating discoveries made by CSIR-IICB



scientists. The overall direction is towards translation of the state-of-the-art fundamental and indigenous innovations to affordable technology for societal benefits of the common man. The role of CSIR-IICB in 'Affordable healthcare through modern science' is well recognized since its early days. We have offered substantial attention in developing drug from our indigenous and natural resources like native Indian plants. I am indeed happy to note that the stride for progress has continued unabated towards excellence and in the last few years we have taken major steps to translate its research results into products for societal benefit. The institute is doing well in terms of technology transfer. Drugs like 'Asmon' and 'Prostalyn' developed by us from Indian medicinal plants are marketed.

CSIR-IICB now holds six major scientific divisions: Cell Biology & Physiology, Infectious Diseases & Immunology, Cancer Biology & Inflammatory Disorder, Organic & Medicinal Chemistry, Molecular Genetics and Structural Biology & Bioinformatics. Scientists are continuing their efforts to unravel the molecular basis of cancer, altered immune responses during chronic infection and inflammation, and the pathophysiology of several metabolic and neurodegenerative disorders such as Diabetes and Alzheimer's disease. CSIR-IICB is one of the major institutes in India which initiated, right from its inception, multi-disciplinary concerted efforts for conducting basic research on infectious diseases, specifically leishmaniasis and cholera, along with the development of technologies for the diagnosis, immunoprophylaxis and chemotherapy of the diseases.

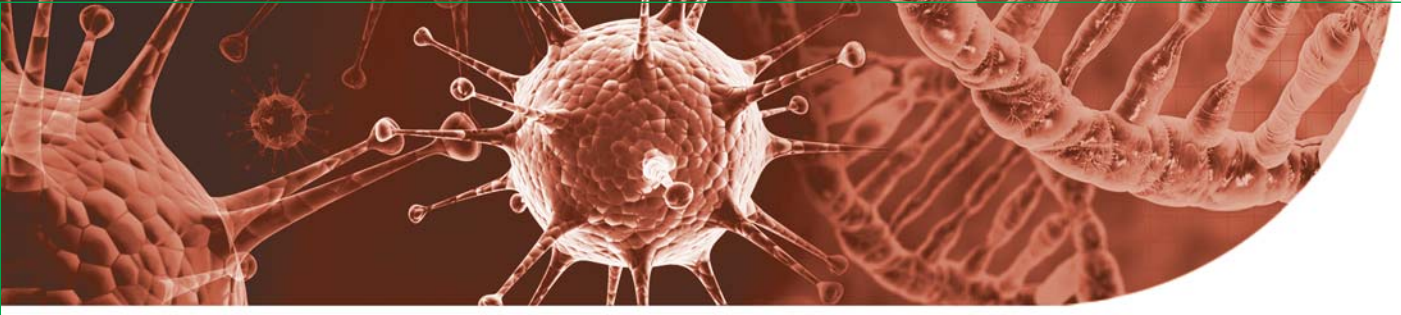
During the reporting period thirty two (32) extramural projects from different funding agencies are continued by different scientists of the institute, which include international projects also. Several new projects have been sanctioned. Based on the expertise available through scientific endeavour, CSIR-IICB was assigned with nineteen (19) Planned Projects of CSIR in the Twelfth Five Year Plan of which five (5) are Nodal Network Projects and fourteen (14) are Partner Network Projects and the idea and initiation of these projects have been highly appreciated by the Research Council (RC) of this Institute. These projects networked with other CSIR labs, will exploit the potential of CSIR-IICB scientists.

On 2nd April, 2016 CSIR-IICB organized its 60th Foundation Day celebration. Prof. Santanu Bhattacharya, Director, Indian Association for the Cultivation of Science, Kolkata was present as Guest-in-Chief and Dr. R. A. Vishwakarma, Director, CSIR-IIIM, Jammu delivered the 28th J.C. Ray Memorial Lecture.

The Institute observed Hindi Week during 7th-14th September, 2016 by organizing different competitions like debate in Hindi, noting & drafting competitions and a workshop was conducted on Unicode. The Institute also celebrated National Hindi Day on 14th September, 2016 and the Hindi patrika, Sanjeevani 2015-2016 was released on that day. The chief guest of the day was Prof. Jagdishwar Chaturvedi, Calcutta University and the Guest of Honor was Dr. Geeta Dubey, Scottish Church College, Kolkata.

The Institute observed the 75th Foundation Day of CSIR on September 28, 2016 at Dr. J. C. Ray Memorial Auditorium of the institute. Prof. Anuradha Lohia, Vice Chancellor, Presidency University, graced the occasion as Guest-in- Chief and Prof. Shekhar C. Mande, Director, National Centre for Cell Science, Pune, delivered the Foundation Day invitation Lecture on "Mapping Protein Flexibility".

CSIR-IICB organized a number of national and international level seminars and symposiums during this reporting period. On 3rd June, 2016 CSIR-IICB organized 2nd B.K. Bachhawat Memorial Lecture and Symposium on Chemical Biology



Research at the J.C. Ray Auditorium of CSIR-IICB, Jadavpur Campus. An Indo-Brazil Symposium on Biochemistry of Kinetoplastid Parasites was organized by the institute during September 19-20, 2016. The main purpose of the symposium was to have an in-depth discussion on different aspects of Leishmania and Trypanosoma researches being carried out in two countries. Twenty five speakers delivered lectures on two different parasites in these two days symposium. On September 27, 2016 Indian Association of Cancer Research (IACR), WB Chapter in association with CSIR-IICB organized a seminar in this institute. There were lectures on recent advances on clinical and basic research on Cancer followed by a short panel discussion. At the end a 'very special' cultural program was presented by the little kids of Thakurpukur Cancer Hospital. India International Science Festival (IISF) Curtain Raiser, Outreach Programme was organized by CSIR-IICB on November 23, 2016 and 3rd International Meet on Advanced Studies in Cell Signaling Network (CeSiN-2016) was organized by CSIR-IICB at Jadavpur Campus during December 18-20, 2016. The 38th Annual Meeting of Plant Tissue Culture Association (India), “PTCA 2017” and the National symposium on “Plant Biotechnology: Current Perspectives on Medicinal and Crop Plants” was organized by CSIR- Indian Institute of Chemical Biology (CSIR-IICB), Kolkata, during 3rd - 5th March, 2017.

The institute organized a one-day training programme for 2016 batch of eighteen IAS Officer Trainees on January 12, 2017 for their Winter Study Tour-cum-Bharat Darshan, in coordination with Govt. of West Bengal.

During the reporting period a number of scientists of our institute received different national honors and awards among which Shanti Swarup Bhatnagar Prize, Fellow of National Academy of Sciences, Allahabad (FNASc), Fellow of Indian Academy of Sciences, Bengaluru, National Bioscience Award, Fellowship of the Royal Society of Chemistry (FRSC), UK, Senior Scientist Platinum Jubilee Fellowship from The National Academy of Sciences, India (NASI) and Young Scientist Award from Indian Peptide Society are important.

A large number of scientists and technologists of national and international repute visited our institute, delivered lectures and held discussions with different research groups in CSIR-IICB during this reporting year. Among which a lecture on "Regulation of Cell Cycle and Replication in Cancer Cells" by Dr. Samarendra K Singh, University of Virginia, Charlottesville, Virginia, USA., visit of Dr Prabuddha Mukherjee, University of Illinois at Urbana Champaign USA for scientific lecture on “Multimodal Imaging in Biological Systems”, visit of Dr. Partha Sarkar, UTMB , Galveston, Texas USA for a lecture on "CAG repeat expansion: the mechanism of neuronal dysfunction and neurodegeneration in Huntington's disease", visit of Srini V. Kaveri, Director, CNRS Office in India ”Embassy of France” New-Delhi for a scientific lecture on "Antibodies: Revisiting the good and bad samaritans", visit of Dr Saumitra Sengupta, Former Vice President, Aurigene Discovery Technologies, Bangalore with a lecture on “Androgen Deprivation therapy for prostate cancer”, visit of Prof. Nitya G. Chakraborty, University of Connecticut, USA for a scientific lecture on “Cell mediated immunotherapy for cancer and the and immune-regulation”, visit of Prof. Kalpana Ghoshal of The Ohio State University for a lecture on “Role of miR-122 in hepatocarcinogenesis”, visit of Dr. Chinmoy Kumar Hazra, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea for scientific lecture on “Exploring New Facets of Organic Synthesis: From Metal to Metal-Free Catalysis” and visit of Dr. Arnab Gupta, Director, SGCCRI, Kolkata for a lecture on “Combating Cancer- Clinician's

perspective" are most significant. About 72 students from different Universities and Institutes of India participated in summer training and other training programmes. A large number of Scientists of our institute were involved in teaching and training programmes of neighbouring universities and institutes.

A steady number of quality publications in journals of high impact factors are the hallmark of the Institute's progress in research. For the year 2016 the total number of scientific publications increased significantly to 250.

CSIR-IICB has always remained as a centre of choice for promising researchers with aspiration to work in biological and chemical fields. This year the institute has attracted a large number of bright, young research fellows and research associates from all over the country to generate adequate and trained human resource in different fields of Biology and Chemistry and related areas for meeting the requirement of cutting edge research. During 2016-17 around 263 fellows and research associates have worked in this Institute.

I extend my warm gratitude to all the staff members of our Institute for their year long sincere activity and cooperation in sustaining the growth and maintaining the reputation of CSIR-IICB. I also believe that the commitments offered by my colleagues will elevate the Institute in a new echelon in near future.

Dr. Samit Chattopadhyay

CSIR-IICB, Kolkata

Cell Biology and Physiology Division

Dr. Sumantra Das (Head till 30.06.2016), Dr. Syed N. Kabir, Dr. Arun Bandyopadhyay(Head), Dr. Sib Sankar Roy, Dr. Sandhya R. Dungdung, Dr. Tushar Chakraborty, Dr. Subhas C Biswas, Dr. Rupasri Ain and Dr. Partha Chakrabarti

The Division of Cell Biology and Physiology comprises an interactive group of eight independent laboratories. The scientists of this division are dedicated to understanding the complex mechanisms governing cell function in the context of tissues, organs, and whole organisms so as to decipher the molecular and cellular mechanisms underlying the pathophysiology of human diseases. Mechanistic studies are being undertaken to understand the various pathophysiology of disease states employing cellular and animal models. Neurodegenerative diseases, cardiac hypertrophy, obesity, diabetes, drug addiction, uteroovarian dysfunction, ovarian development, developmental neurobiology, placental morphogenesis, sperm motility are the major areas of interest for the group. Another hallmark of the division is its culture of collaboration, both at the intra- as well as at the inter-institutional levels. Many of the members of the division actively participate in postgraduate teaching at various Universities in addition to mentoring Ph.D. students and summer trainees. Regular biweekly journal clubs are organized, which are enthusiastically attended by both students and faculty. These seminars cover the latest developments in the field and are given generally by the graduate students in the Division. The nature of research carried out in the individual laboratories of the division is detailed below.

Dr. Arun Bandyopadhyay

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Plasma proteomics in rheumatic heart disease and coronary artery disease

Participants

JRF: Debasmita Chakraborty, Alipta Guha Roy, Ritu Goutam

SRF: Tanima Banerjee, Sayantan Sengupta, Apabrita Ayan Das, Dibyanti Mukherjee, Sumanta, Narayan Nandi, SRF

Research Associate: Kamalika Roychoudhury, Vivek Chander

Technician: Swapan Mandal,

Collaborator(s)

Collaborators outside CSIR-IICB

Dr. Santanu Dutta, Sudip Ghos

PGMEIR, SSKM Hospital, Kolkata

Dr. Prakash Chandra Mandal

Appollo Glneagles Hospital, Kolkata.

Background

The traditional approach to study cardiovascular disease (CVD) and develop new biomarkers was to look at one or a few candidate molecules. But, the advent of new proteomic techniques in CVD research allows analysing the expression of a plethora of proteins at one go. Proteomics and bioinformatics are powerful tools to identify protein based biomarkers involved in a disease state. The current advancement in proteomic technologies helps studying global protein expression changes associated with human disease processes. One of the advantages of these proteomic studies is that new biomarkers (diagnostic and/or prognostic) can be discovered which will help provide a better framework for treatment of cardiovascular diseases. Thus, the detection, identification and characterization of variations in the proteome occurring during the course of heart disease will provide both (i) insight into the underlying molecular mechanisms and (ii) potential cardiac specific biomarkers for regular, systematic observation and assessment of cardiac status.

Aims and Objectives

- The aim of this study was to provide a list of potential blood based protein markers for RHD and CAD.

Work Acheived

We utilized on-line label-free MS/MS using blood plasma as the source material. On-line LC-ESI-MS is the method of choice because the initial LC separation step decreases the amount of analytes that can be simultaneously ionized. Thus, the possibility of ion suppression is reduced rendering the method quantitative in nature. Such label-free quantitative LC-MS approaches can compare innumerable samples. Therefore, they are ideal for biomarker discovery because experimental workflows normally compare a large number of specimens to validate the results from a statistical point of view. Consequently, the label-free quantitative LC-MS methods employed in this thesis helped analyse the full potential of clinical plasma samples as a source of disease biomarkers in RHD and CAD respectively. Some of which might play important roles in the pathophysiology of RHD and CAD and improve the existing diagnostic strategies. Taken together, it may be said that the results of the proteome analysis may be useful to understand the pathophysiological changes associated with RHD and CAD. Some of the altered protein(s) unique to these diseases might qualify as potential CVD biomarker(s). Those biomarkers may be utilized for the development of diagnostics which in turn, would help therapeutic intervention timely and might save human lives.

Future Research Plans

Validation of altered proteins in larger cohorts.

Understanding the mechanism of altered proteins.

PUBLICATIONS

Mukherjee S., and Bandyopadhyay A. (2016) Proteomics in India: the clinical aspect. *Clin Proteomics* **13,** 21

INVITED TALKS

Analysis of human plasma in Rheumatic heart disease; Indo US workshop and 8th Annual Meeting of Proteomics Society (I), NIPGER, 14-17 December, 2016, New Delhi, India.

Plasma proteomics in Rheumatic Heart Disease and Coronary Artery Disease; 14th Annual Meeting of International Society of Heart Research (Indian Section), CSIR-IGIB, 27-29 January, 2017, New Delhi, India.

Mechanism of Mitochondrial Dysfunction in Hypertrophied Cardiomyocyte; International Conference on Molecular Signalling: Basics to Applications (ICMS-2017), Anna University 10-12 January, 2017, Chennai, India.

Clinical Proteomics: Cardiovascular Disease, National Symposium and Workshop on Quantitative Proteomics, Institute of Life Science, 6 March, 2017, Bhubaneswar, India.

Dr. Sib Sankar Roy

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Understanding the molecular mechanism and pathophysiology of metabolic disorder

Participants

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Project Fellow: Shreya Roy Chowdhury

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Prof. Debasish Bandyopadhyay & Prof. Urmi Chatterjee
University of Calcutta, Kolkata

Prof. Siddhartha Roy
Bose Institute, Kolkata

Prof. Arindam Banerjee
IACS, Kolkata

Dr. Sunirmal Jana
CSIR-CGCRI, Kolkata

Prof. B. P. Chatterjee
West Bengal University of Technology, Kolkata

Collaborators within CSIR-IICB

Dr. Samit Chattopadhyay
Cancer Biology and Inflammatory Disorder Division

Dr. P. Jaishankar
Organic and Medicinal Chemistry Division

Background

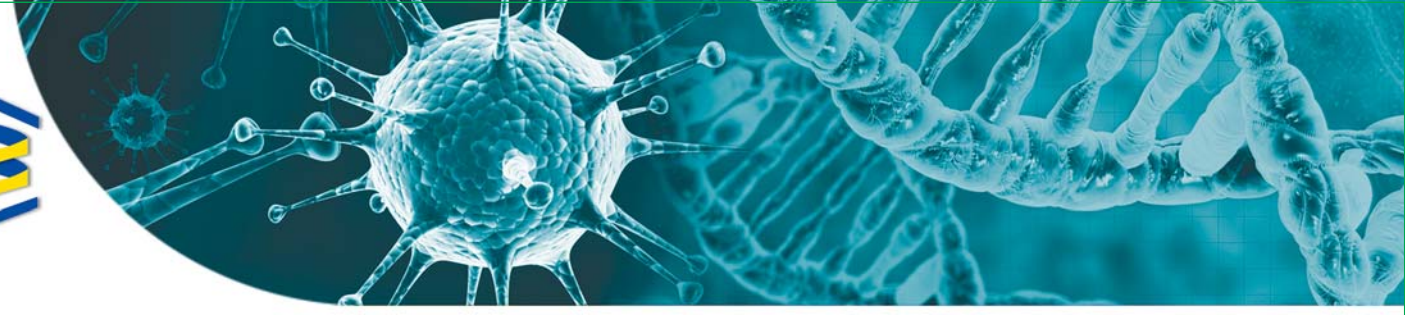
Cancer and insulin resistance are regarded as the two most rising metabolic problems all over the world. Lifestyle and food habit in current times are the foremost factors responsible for the rising incidence of these two disorders. Absence of efficient and adequate therapeutic measures aggravates the problem in most of the cases. Therefore, understanding the basic biology associated with the diseases is the current necessity to widen our knowledge and explore new arenas for improvised therapeutics. Early diagnosis issues and chemoresistance / recurrence in cancer are the major areas of concern that needs to be addressed. On this background, reports suggest that ovarian pathology is the current area, which entails the widest and most complex problems in modern gynecology, mainly involving ovarian tumors. The high mortality events associated with ovarian cancer is due to its asymptomatic nature leading to the diagnosis with disseminated intraperitoneal carcinomatosis. Thereby, our approach was to explore the mechanism of initiation and progression of such diseases in suitable model-systems that might help to open new therapeutic strategies. Further, we would like to identify the possible drug targets and plausible diagnostic markers related to the different stages of disease progression.

Aims and Objectives:

- To unravel the metabolites and growth factors-mediated signaling network that leads to the mesenchymal switch and invasion in ovarian cancer.
- Molecular cross talks during cancer progression and the induction of stemness/ chemoresistance in ovarian cancer.
- Understanding the metabolic adaptability and its association with invasive potential in cancer cells.
- Characterization of a plant-derived lectin to show its efficacy for targeted apoptosis in ovarian cancer cells
- To identify the relevant therapeutic targets associated with obesity-induced insulin resistance

Work Achieved

To unravel the metabolites and growth factors-mediated signaling network that leads to the mesenchymal switch and invasion in ovarian cancer: Extravasation and metastatic progression are the two main reasons for high mortality rate associated with ovarian cancer. Thus, identifying the molecular mechanisms underlying aggressiveness of ovarian cancer is the need of current time. Our earlier data showed that Ets-1 protooncogene is upregulated by grwith factor and directs it to localize in the nucleus from cytoplasm (Ghosh et.al. JBC-2012). In continuation, our ongoing research focuses on the regulation of expression and nuclear translocation of ETS-1, that is required for the activation of MMPs (*Roy Chowdhury et al.* MS under preparation). We identified the role of FGF-16 towards increased proliferation/invasion in ovarian cancer

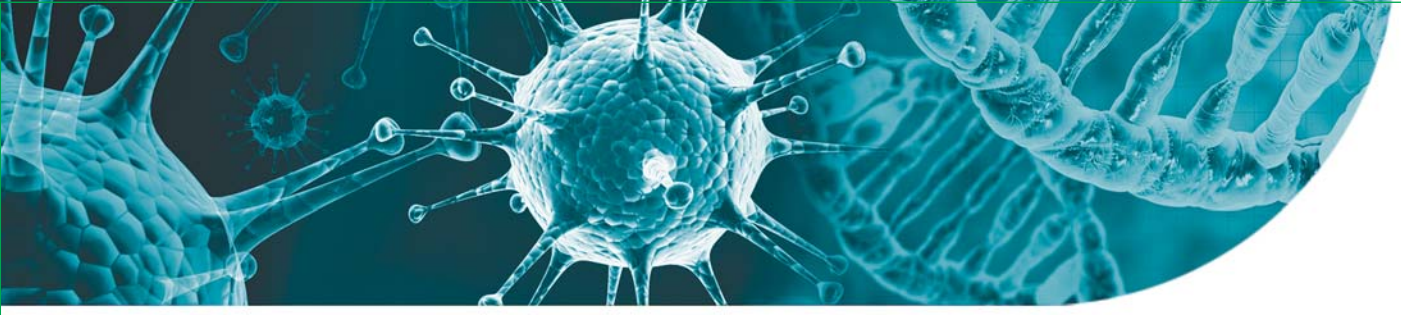


(Basu et.al. JBC-2014). We have also identified the existence of increased invasion in ovarian cancer cells through the regulation of TGF-β and activin-A signaling pathways (Basu et.al. Mol Cancer 2015). Our ongoing studies decipher the role of fibroblast growth factor (FGF), in mediating the differential splicing of specific GF receptor genes that regulates EMT in ovarian cancer cells (*Bhattacharya et.al.* MS communicated). In addition to the role of growth factors, current documentations highlighted the importance of metabolites in the progression of cancer. On this aspect, we showed that lyso-phosphatidic acid (LPA), a key oncometabolite gets significantly enriched in the serum and ascitic fluid of ovarian cancer patients. It leads to the mesenchymal switch through the regulation of a critical histone deacetylase and an EMT regulator, Sirt1 **(Ray et al. Cell Physiol. Biochem 2017).**

Molecular cross talks during cancer progression and the induction of stemness/chemoresistance in ovarian cancer: Different signaling cascades in cancer cells determine the fate of tumor progression through positive and negative feedback loop. The existence of cross-talk between the Wnt-signalling pathway and FGF-16 signaling has been shown to promote the aggressiveness in OC (Basu et.al. JBC-2014). A positive feedback loop between Wnt-signaling and PITX2-homeodomain transcription factor controls cancer cell proliferation (Basu et.al JBC-2013). A critical cross-regulation between the TGF-β and Wnt signalling pathways has been shown to exist, which was found to synergistically reduce the EMT in OC cells **(Mitra et.al. Cell Physiol. Biochem-2017).** The effect of one growth-factor (VEGF) towards the critical regulation of another family of growth factors (FGF) to induce EMT and invasion in OC cells has been investigated (*Bhattacharya et.al.* MS under review). Moreover, the mechanism behind TGF-β-induced stemness and chemoresistance has been studied in detail.

Metabolic adaptability and its association with invasive potential in cancer cells: Metastatic potential of transformed cells depends on a plethora of metabolic challenges prevailing within the tumor microenvironment. To achieve higher rates of proliferation, the transformed cells rewire their metabolic demands leading to increased biosynthetic activities. Current researches focusses on the metabolic reprogramming of the cancer cells, which predisposes the cells towards increased oncogenesis. Given the significance of altered metabolism in transformed cells, we aimed to study the metabolic rewiring of ovarian cancer cells in response to metabolite signaling. A key metabolite associated with ovarian cancer pathogenesis is the lyso-phosphatidic acid (LPA). Prior studies establish its involvement towards metastasis in ovarian cancer. Based on latest studies that links metabolic rewiring to the invasive phenotype of transformed cells, we uncovered the contribution of LPA towards the metabolic adaptations in ovarian cancer cells. We obtained metabolic predisposition of the ovarian cancer cells towards glycolysis by LPA, which was not observed in the non-transformed cells. We obtained the critical involvement of ETS-1 oncogene through RNA-Seq analysis, towards the LPA-induced glycolytic predisposition and up-regulation of MMPs, ultimately resulting in increased invasion of cancer cells **(Ray et.al, MS In Press, Molecular Oncology 2017).** Furthermore, we also found that the growth factor EGF altered the metabolic adaptability of the cancer cells towards increased glycolysis leading to enhanced cellular invasion (*Roy Chowdhury et al.* MS under preparation). Our ongoing studies furthur focusses on targeting the metabolic adaptations of the cancer cells to decipher that whether it can enhance the efficacy of the existing anti-cancer drugs in ovarian cancer.

Characterization of a plant-derived lectin to show its efficacy for targeted apoptosis in ovarian cancer cells: Cancer cells deploy various defense strategies to sustain the tumor microenvironment, among which deregulated apoptosis remains a versatile promoter of cancer progression. Although recent research has focused on identifying agents capable of inducing apoptosis in cancer cells, yet molecules efficiently breaching their survival advantage are yet to be classified. Here we identify lectin, *Sambucus nigra* agglutinin (SNA) to exhibit selectivity towards identifying OC by virtue of its specific recognition of α-2, 6-linked sialic acids. Our findings position SNA at a crucial juncture where it proves to be a promising candidate for impeding progression of OC. Altogether we unveil the novel aspect of identifying natural molecules harboring the inherent capability of targeting mitochondrial structural dynamics, to hold the future for developing non-toxic therapeutics for treating OC **(Roy Chowdhury et al, MS In Press, Cell Death & Disease, 2017).**



To identify the relevant therapeutic targets associated with obesity-induced insulin resistance: Mitochondrial dysfunction is closely associated with obesity-induced metabolic complication. Mitochondrial ROS generation followed by inflammation majorly contributes towards metabolic alteration in pathophysiology of obesity-linked T2DM. Mitochondrial fission and other dysfunction generates metabolites like ceramides, which are directly associated with insulin resistance (IR). The possible role of differential expression of mitochondrial transporters (CPT1/2, Bhattacharjee et al, CPB-2015) in lipid-induced IR contributes towards reduced GLUT4 translocation in skeletal muscles. We have identified another factor, Thioredoxin Interacting Protein (TxNIP) to be critically associated with lipid-induced ROS generation and glucose uptake in skeletal muscle milieu **(Mandala et al, BBRC, 2016).** Currently we investigate the mitochondrial dynamics and its bioenergetic efficiency by extracellular flux analysis. Presently we are involved in extracting anti-diabetic compounds from natural products and study their effects on the above mentioned therapeutic targets.

Non-alcoholic fatty liver disease (NAFLD) followed by liver fibrosis is another serious risk adorning obesity. People suffering from NAFLD are asymptomatic and due to lack of early diagnosis aggravate the deadly disorder. Therefore, understanding the mechanism behind obesity induced liver fibrosis development would shed some light about its diagnosis and treatment. In order to develop the high fat diet-induced obese rat model, the animal were fed with diet having different conc of fat. We observed that 60% fat-containing diet was most effective in causing oxidative stress and mitochondrial dysfunctions **(Das et al, Food Function, 2017, In Press).** Further, to unravel the factors associated with NAFLD, we performed transcriptomics and identified retinol metabolism as one of the metabolic pathway significantly deregulated during obesity. The biologically active metabolite of retinol, Retinoic acid has been implemented in treatment of obesity. Here we identified the underpinning mechanism behind deregulation of retinol metabolism leading to liver fibrosis, which could serve as a future prognostic marker for NASH (*Das et al,* MS ready for communication). In addition, we have researched about the unexplored potential of melatonin in diminishing obesity induced liver fibrosis by attenuating the stellate cell activation responsible for fibrogenesis process (**Das et al, under revision, J Pineal Res, 2017).**

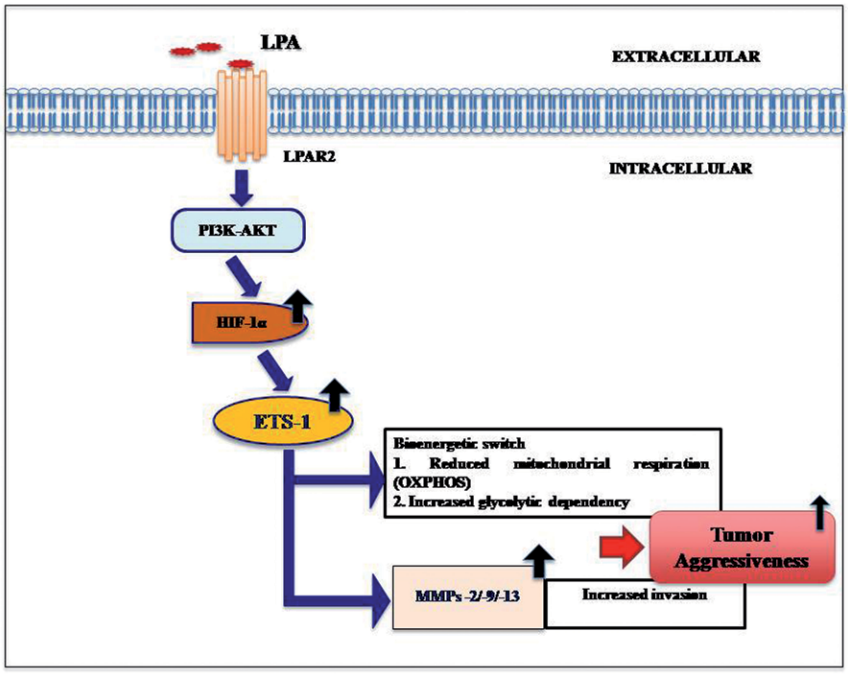


Fig. 1: Schematic representation depicting the mechanism of LPA-induced metabolic rewiring and invasion in ovarian cancer cells.

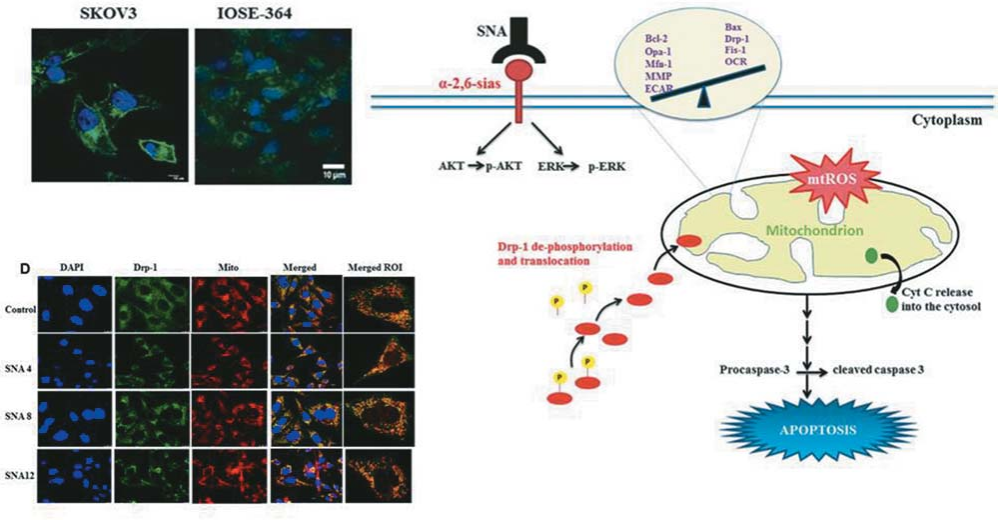


Fig. 2: Localization of SNA (lectin) in the tumour cell surface. Microscopic images of co-localization of Drp-1 (green) with mitochondria (red) in OAW-42 cells treated with SNA for the mentioned time points. ROI indicates merged region of interest. Scale bar = 10μm. The schematic representation SNA-mediated induction of apoptosis in ovarian cancer cells.

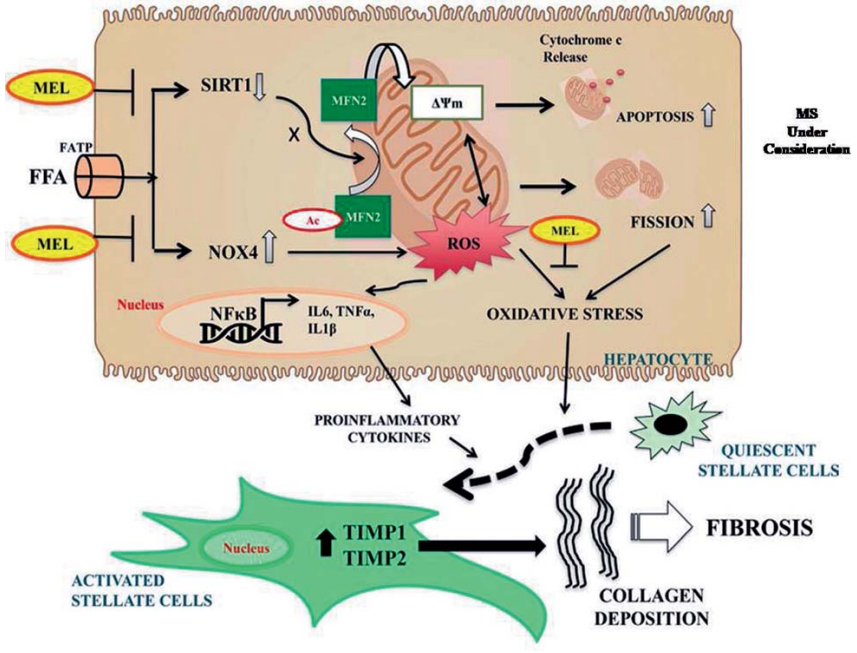
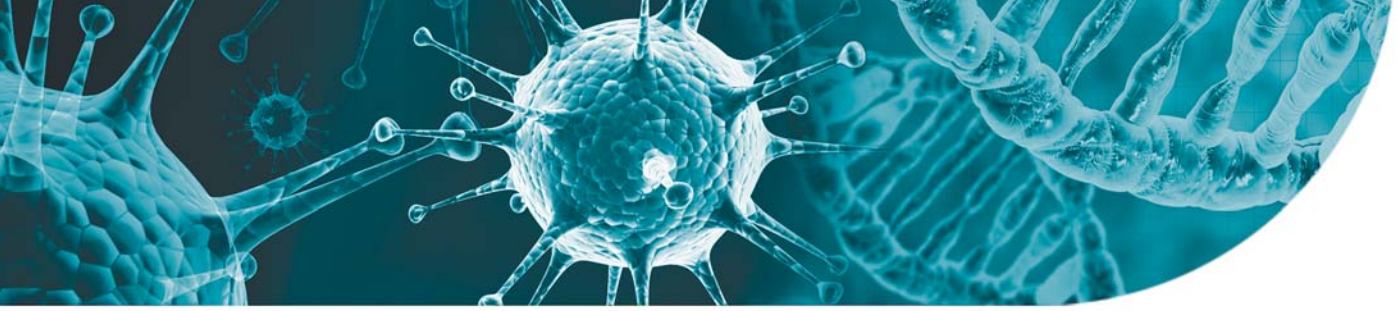


Fig. 3: A schematic model depicting the entire proposed mechanism of action of melatonin in combating stellate cell activation and retarding the process of fibrogenesis during NAFLD.



PUBLICATIONS

Mandala A., Das N., Bhattacharjee S., Mukherjee B., Mukhopadhyay S. and Roy S. S. (2016) Thioredoxin interacting protein mediates lipid-induced impairment of glucose uptake in skeletal muscle. *Biochem Biophys Res Commun* **479,** 933-939

Datta S., Choudhury D., Das A., Das Mukherjee D., Das N., Roy S.S. and Chakrabarti G. (2017) Paclitaxel resistance development is associated with biphasic changes in reactive oxygen species, mitochondrial membrane potential and autophagy with elevated energy production capacity in lung cancer cells: A chronological study. *Tumour Biol* **39,** 1010428317694314

Pradhan A., Bepari M., Maity P., Roy S.S., Roy S. and Maiti Choudhury S. (2016) Gold nanoparticles from indole-3-carbinol exhibit cytotoxic, genotoxic and antineoplastic effects through the induction of apoptosis. *RSC Advs* **6,** 56435-56449.

Naskar A., Bera S., Bhattacharya R., Saha P. and Roy S.S. (2016) Synthesis, characterization and antibacterial activity of Ag incorporated ZnO-graphene nanocomposites. *RSC Advs* **6,** 88751-88761.

Ray U., Roy S.S. and Chowdhury S.R. (2017) Lysophosphatidic Acid Promotes Epithelial to Mesenchymal Transition in Ovarian Cancer Cells by Repressing SIRT1. *Cell Physiol Biochem* **41,** 795-805.

Mitra T. and Roy S.S. (2017) Co-Activation of TGFbeta and Wnt Signalling Pathways Abrogates EMT in Ovarian Cancer Cells. *Cell Physiol Biochem* **41,** 1336-1345

Das N., Mandala A., Bhattacharjee S., Mukherjee D., Bandyopadhyay D. and Roy S.S. (2017) Dietary fat proportionately enhances oxidative stress and glucose intolerance followed by impaired expression of the genes associated with mitochondrial biogenesis. *Food Funct* **8,** 1577-1586

Chowdhury S.R., Ray U., Chatterjee B.P. and Roy S.S. (2017) Targeted apoptosis in ovarian cancer cells through mitochondrial dysfunction in response to Sambucus nigra agglutinin. *Cell Death Dis* **8,** e276

Ray U., Roy Chowdhury S., Vasudevan M., Bankar K., Roychoudhury S. and Roy S.S. (2017) Gene regulatory networking reveals the molecular cue to lysophosphatidic acid-induced metabolic adaptations in ovarian cancer cells. *Mol Oncol* **11,** 491-516

EXTRAMURAL FUNDING

'Mechanism of Ets-1 transcription factor-mediated metabolic reprogramming and tumorigenesis in ovarian cancer.' EMR/2016/002578. 24.03.2017 to 23.03.2020 (DST, SERB, Govt of India).

CONFERENCES / WORKSHOPS

Number of abstracts India: 6

INVITED TALKS

Metabolic reprogramming in the tumor cells promotes EMT and invasion; Sri Venkateswara University; 104 th Indian Science Congress, 3-7 January, 2017, Tirupati, India.

Metabolic reprogramming and cancer progression; Anna University-KBC Research Centre; 5th International conference on molecular signaling: Basics to Applications, 10-12 January, 2017, Chennai, India.

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Evaluation of spermicidal efficacy of VRP, a synthetic cationic antimicrobial peptide

Participants

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Collaborator(s)

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IVF & Infertility Research Centre
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Collaborators within CSIR-IICB

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Cancer Biology and Inflammatory Disorder Division

Dr. P. Jaishankar
Organic and Medicinal Chemistry Division

Background

Spermatozoon is a terminally differentiated cell where signaling through cell membrane controls most of the vital cellular events. Rapid action of spermicides is mostly an event mediated through cell surface by alterations in membrane structure and physiology. Spermicides are capable of killing 100% human sperm almost instantaneously at physiological concentrations *in vitro* are likely to provide adequate pregnancy protection *in vivo.* The small synthetic peptide VRP possesses antimicrobial properties against a number of gram positive, gram negative bacteria and fungi but less toxic to human RBC and murine fibroblast 3T3 cells. Therefore this peptide has been picked up to identify its crucial role in sperm motility and viability.

Aims and Objectives

- To elucidate the effect of synthetic peptide VRP on sperm motility, morphology, effect on vaginal microflora and it's potential as a safe contraceptive.

Work Achieved

VRP being a potent antimicrobial and less cytotoxic compound its human sperm immobilizing property and spermicidal efficacy has been elucidated. VRP at 350 µM concentration irreversibly immobilize human sperm within 20 seconds as observed by Sander-Cramer assay. Further sperm cells viability and membrane integrity were checked by Eosin-Nigrosin staining and Hyposmotic Swelling Assay and at 350 µM concentration 95% human sperm cells lost their viability and membrane integrity, which confirmed immobilization effect leading to cell death **(Fig. 1)**.

FACS data revealed that treatment with VRP significantly increased the count of FITC-annexin-V positive apoptotic cells from 9% (control) to 47% and 64% respectively in 50 and 100 µM VRP treated cells and confirmed VRP induces apoptosis in human sperm cells. VRP treatment significantly increased all the cytochrome C, caspase 9 and caspase 3 levels in human sperm, confirming the induction of intrinsic apoptotic pathways. The extrinsic apoptotic pathway initiator caspase 8 was also checked and the results showed that active caspase 8 was also significantly increased and its effector active caspase 3 was also increased. VRP significantly increased DNA damage from 6% (Control) to 19 % and 33% on 50 and 100 µM VRP treated cells and positive control cells showed 35% damage. At present, most widely used spermicidal agent nonoxynol-9 morphologically disrupts cell membrane, acrosomal cap, midpiece and mitochondrial cristae of sperm cells leading to cell death, but frequent use of it caused vaginal lesions, viral infections and killing of residential microflora. So, the effect of VRP on human sperm morphology was also studied by atomic force microscopy (AFM) and Scanning electron microscopy (SEM) and pictures confirmed that VRP at 350 µM concentration acrosomal cap ruptured and membrane integrity of head and midpiece region disrupted those are crucial for cell viability and fertilization competence. Mitochondria are located in the midpiece of spermatozoa in a spiral assembly and act as the energy house. VRP also disrupted the midpiece and mitochondrial spiral assembly structure as it is clearly visible in the AFM imaging **(Fig. 2).** Alteration of mitochondrial outer membrane permeabilization which causes the release of Cyt c is the central event of apoptosis. As VRP also affected the midpiece of spermatozoa, so, the transition of mitochondrial permeability by mitochondrial permeability transition pore (MPTP) formation assay was also checked using calcein as

fluorescent probe and $CoCl_2$ as its bleaching agent. MitoTracker Red and DAPI were used to label the mitochondria and nucleus respectively. Result showed that control cells containing healthy mitochondria retained the calcein (green) and mitoTracker red, as $CoCl_2$ can't penetrate healthy mitochondria and thus coloured greenish yellow. Whereas, both VRP (100 µM) and ionomycin (+ve control) treated cells lost their calcein stain due to pore formation in outer membrane and retained mitoTracker red colour only **(Fig. 3)**. Hence, VRP hampered the mitochondrial membrane potential and induced apoptosis. Lactobacilli are largely populated in healthy vagina where it produce lactic acid and other antimicrobial substances and perhaps prevent different disease and inflammation. Effect of VRP on *Lactobacillus acidophilus* was checked by MTT assay method and found the growth of *Lactobacillus acidophilus* was not affected much.

The present study revealed that synthetic antimicrobial peptide VRP designed on the basis of heptad repeat of valine, exhibited progressive forward motility inhibition and spermicidal activity in human sperm cells by inducing both extrinsic and intrinsic apoptotic pathways. It also morphologically disrupted the sperm cells and altered the mitrochondrial membrane permeability but the viability of vaginal microflora did not affect much. Therefore, VRP may be a promising microbicidal vaginal contraceptive molecule, worthy of further consideration for the future contraceptive drug development.

Future Research Plans

Identification and functional characterization of sperm motility regulators from reproductive fluids and elucidate their roles on fertility and infertility management.

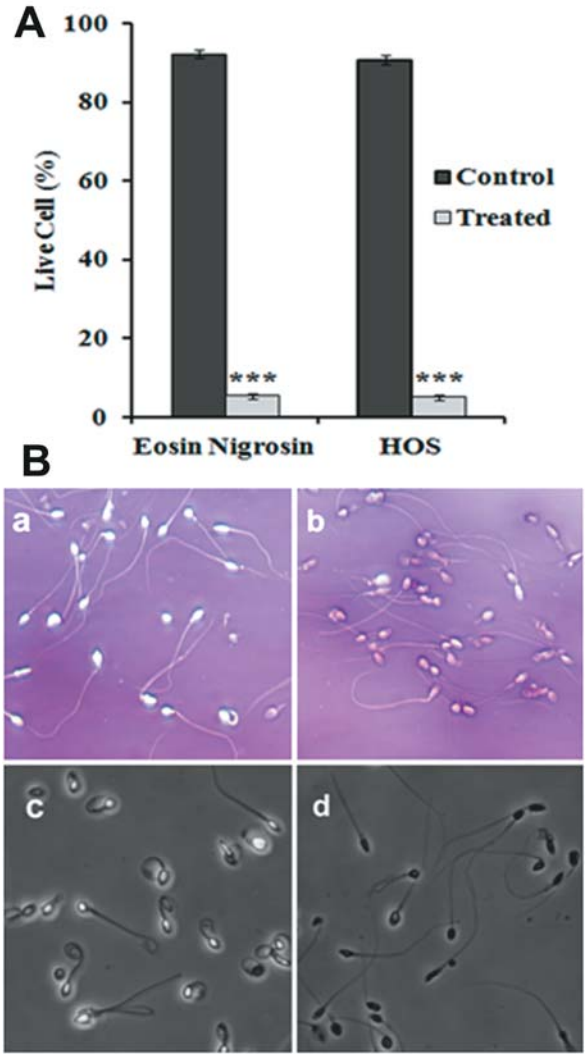

Fig. 1: Effect of VRP on viability of human spermatozoa was done by eosin-nigrosin staining and hypoosmotic swelling (HOS) test under light and phase contrast microscopy. (A) Quantitative evaluation of live and dead cells expressed as percentage of live cells. (B) Photographic representation of eosin unstained live cells, white head (a), eosin stained dead cells, dark head (b), HOS reactive live cells, coiled tail (c) and HOS non reactive dead cells, uncoiled tail (d).

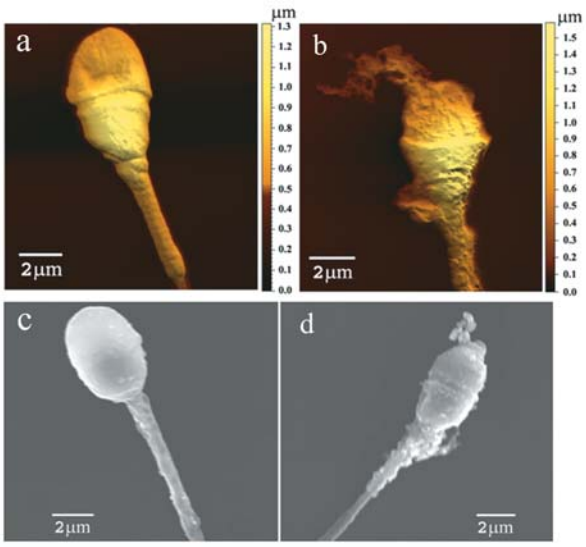

Fig. 2: Representative images of high resolution microscopy showing morphological changes on VRP treated human sperm head and midpiece. Atomic force microscopy and scanning electron microscopy show an intact acrosomal cap and midpiece in control cells (a & c) but a disrupted acrosomal cap and midpiece in 350 µM VRP-treated cells (b & d).

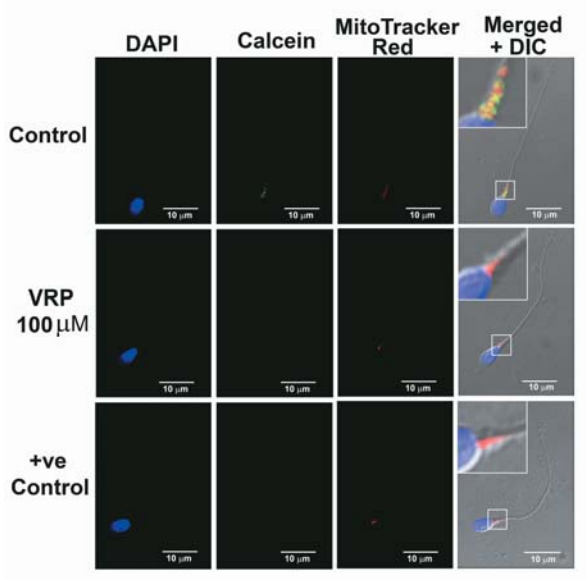

Fig. 3: Induction of mitochondrial permeability transition pore formation. Control cells show green fluorescence of calcein (intact mitochondrial membrane) but 100 µM VRP-treated and positive control (1 µM ionomycin-treated) cells show loss of green fluorescence (damaged mitochondrial membrane). Mito Tracker Red and DAPI were used to stain mitochondria and nucleus. Merged + DIC panel shows whole sperm cells. Inset showing the magnification of mitochondria containing midpiece area.

PUBLICATIONS

Book Chapters / Invited Reviews

Dungdung S.R., Bhoumik A., Saha S., Ghosh P., Das K. and Mukherjee S. (2016) Sperm Motility Regulatory Proteins: A Tool to Enhance Sperm Quality. Review in Book: Insights from Animal Reproduction, InTech, Rijeka, Croatia (Ed. Dr. Rita Payan). ISBN: 978-953-51-4629-2, pp 161-177.

CONFERENCES / WORKSHOPS

Number of abstracts

India: 1

INVITED TALKS

Life style, male infertility and fertility regulators. The Physiological Society of India (PHYSIOCON-2016), 18-20 November, 2016, Midnapore College, Midnapore, West Bengal, India.

Dr. Subhas Ch. Biswas
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Tribbles Pseudokinase 3 (Trib3) induces both apoptosis and autophagy in a model of Alzheimer's disease

Participants

JRF: Pallabi Bhattacharyya

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Women Scientist: Kusumika Garami, Rebecca Banerjee

Project Assistant: Hrishita Das

Collaborator(s)

Collaborators outside CSIR-IICB

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Collaborators within CSIR-IICB

Dr. P. Jaishankar, Dr. Indubhushan Deb, Dr. Biswajit Banerjee, Dr. R. Natarajan & Dr. Ranjan Jana
Organic & Medicinal Chemistry

Background

Amyloid-β (Aβ) induced neuron death is considered central to the pathogenesis of Alzheimer's disease (AD). Among several death modalities, autophagy and apoptosis play important roles in Aβ-induced neuron death suggesting that there may be regulatory mechanisms that initiate both cell death pathways. However, molecules that govern both pathways have not been identified. Recent studies indicate the dynamic participation of ER stress in activating autophagy and promoting apoptosis of tumour cells, wherein Trib3 leads the saga by inhibiting Akt and mTORC1 in turn leading to enhanced autophagy and subsequent apoptosis in cancerous cells. Trib3 is a mammalian ortholog of the Drosophila *Tribbles* gene and is also known as neuronal death-inducible putative kinase/ Sink1/ Skip3. Trib3 is responsible for a plethora of functions ranging from glucose regulation, migration of tumour cells, suppressing differentiation of adipocytes and cell cycle control. It was identified as a novel ER stress inducible gene which when upregulated activated several genes involved in cell death during ER stress. Trib3 is also shown to be elevated by severalstresses including hypoxia, 6-hydroxy dopamine, growth factor deprivation, anoxia and ethanol exposure. It has also been shown that Trib3 is elevated in Parkinson's disease (PD) brains and mediates neuron death in various PD models. Trib3 is a pseudokinase as it lacks the catalytic residues required for its kinase function. Bioinformatic analysis of Trib3 protein reveals presence of a number of conserved domains which account for its ability to interact with numerous protein binding partners. We have investigated the role of Trib3 in neuronal death induced by Aβ.

Aims and Objectives

- To investigate the role of Trib3 in neuronal death induced by Aβ
- To determine the role of apoptosis and autophagy in neuronal death in evoked by Aβ

Work Achieved

Our work revealed that, upon Aβ treatment, Trib3 is upregulated in neurons, both *in vivo* and *in vitro*. Increased Trib3 levels inhibited the activity of the kinase Akt by interacting with it. As a result, forkhead box O1 (FoxO1), a transcription factor that is negatively regulated by Akt, was activated, translocated to the nucleus, and induced the pro-apoptotic gene *BCL2 like 11* (Bim). Conversely, FoxO1 responded to Aβ insult by binding to the *Trib3* gene promoter, enhancing its expression. Our investigations further revealed that Trib3 also induces autophagy. We found that Trib3 indirectly activates unc-51 like autophagy activating kinase1 (ULK1) by impeding phosphorylation of, and thus inactivating, a negative regulator of ULK1, mechanistic target of rapamycin (mTOR). ULK1 activation augmented autophagosome formation and reduced autophagy flux. Thus, Trib3 was required for formation of autophagosomes, which accumulated in neurons as autophagic flux was thwarted. Most importantly, silencing endogenous Trib3 strongly protected neurons from Aβ insult. Our results suggest that a self-amplifying feed-forward loop among Trib3, Akt, and FoxO1 in Aβ-treated neurons induces both apoptosis and autophagy, culminating in neuron death. Thus, Trib3 may serve as potential therapeutic target for AD.

Future Research Plans

Development of diagnostics and therapeutics for neurological disorders.

We have already designed and synthesized several novel lead molecules based on established pathways and targets which have shown significant efficacy in cell models of AD or PD. These lead molecules will be evaluated in animals for toxicity and efficacy. Human samples (CSF, plasma and peripheral blood mononuclear cells) shall be collected based on the neuropsychology and other initial evaluations done on potential early stage of AD and PD patients. Analysis of the presence of novel biomarkers such mitochondrial DNA mutations and alteration in protein levels or activity, disease specific secretary proteins and miRNA along with known disease-specific biomarkers such as beta-amyloid oligoners, phospho-Tau, alpha-syneuclin will be undertaken. Finally, a disease specific multimodal diagnostic tool would be developed.

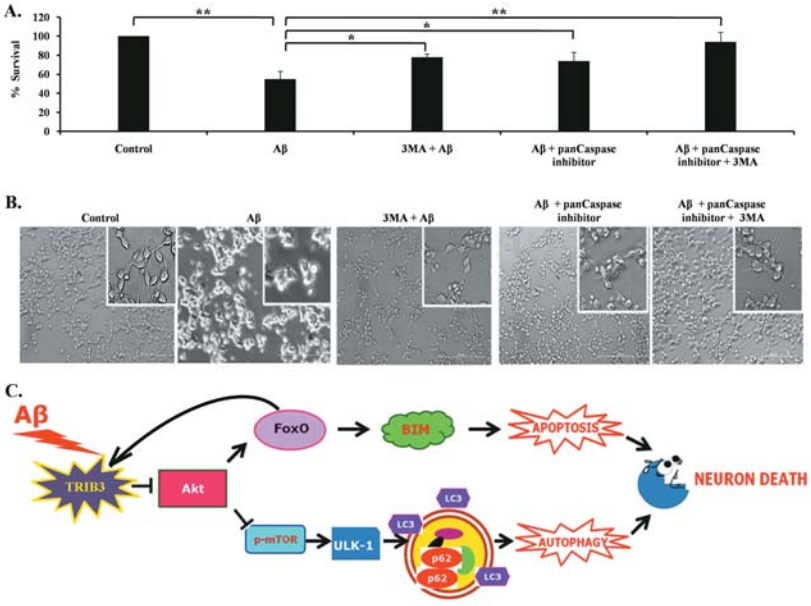

Fig. 1: Contribution of both autophagy and apoptosis in Aâ induced neuronal cell death. (A) Graphical representation of cell survival following Aâ treatment with pan caspase inhibitor and 3-MA, or both, for 16 h. Data represented as mean ± SEM of 3 independent experiments. *p < 0.05, **p < 0.001. (B) Representative Phase contrast micrographs of neuronal PC12 cells before and after treatment of Aâ for 16 h. (C) Trib3 is upregulated upon Aâ exposure, Trib3 then interacts with Akt and inhibits its phosphorylation, as a result of which two molecules are affected. On one hand, FoxO gets activated, translocates to the nucleus and causes transcription of the pro-apoptotic protein Bim, FoxO also binds to the promoter region of Trib3 amplifying the feed forward loop between them. On the other handmTOR gets inhibited, as a result of which Ulk1 is activated which then initiates the autophagic cascade as seen by the induction of cleavage of LC3 and increased accumulation of p62. Trib3 thus designs death of neurons by both autophagy and apoptosis.

PUBLICATIONS

Chatterjee N., Sanphui P., Kemeny S., Greene L.A. and Biswas S.C. **(2016)** Role and regulation of Cdc25A phosphatase in neuron death induced by NGF deprivation or β-amyloid. *Cell Death Discovery* **2:**16083

Saleem S. and Biswas S.C. **(2017)** Tribbles Pseudokinase 3 Induces Bothn Apoptosis and Autophagy in Amyloid-β-induced Neuronal Death. *Journal of Biological Chemistry* **292:** 2571-2585

Book Chapters / Invited Reviews

Subhas Chandra Biswas, Priyankar Sanphui, Nandini Chatterjee, Stav Kemeny and Lloyd A. Greene (2017) Cdc25A phosphatase: a key cell cycle protein that regulates neuron death in disease and development. *Cell Death Disease* **8**:e2692

AWARDS / HONOURS / MEMBERSHIPS

Student's Award

Subhalaksmi Guha

1st Prize in Oral presentation, Conference on Neural Functions of the Aging Brain, Trivendram, Kerala

3rd Prize in Poster presentatyion, Conference on Neurodegenerative Disorders: Current and Future Perspective, Kolkata

EXTRAMURAL FUNDING

Alzheimer's disease: identification of common targets regulating both apoptosis and autophagy during neurodegeneration. 2017-2020 (DST, Govt. of India)

CONFERENCES / WORKSHOPS

Number of abstracts

India: 22 International: 1

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

NeuroUpdate; Nov 26, 2016; IICB, Kolkata

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Evaluation of spermicidal efficacy of VRP, a synthetic cationic antimicrobial peptide

Participants

JRF: Nanda Singh, Rumela Bose

SRF: Sarbani Saha Shreeta Chakraborty, Trishita Basak, Debdyuti Nandi,

Project Assistant: Safirul Islam

Research Associate: Abhishek Jaiswal

Background

The placenta is an extra-embryonic tissue that provides the physiological interface between mother and fetus and is critically involved in controlling the environment in which the embryo/fetus develops. Placental morphogenesis includes a) differentiation of trophoblast stem cells into multilineage pathway, b) epithelial mesenchymal transition of trophoblast cells imparting invasive phenotype, c) extensive angiogenesis. Disruptions in placental development can lead to early pregnancy loss, intrauterine growth retardation (IUGR), and tumorigenesis. These represent serious health problems whose etiologies are not sufficiently understood. The goal of our research is to further our understanding of cellular interaction and molecular regulation of placental development and trophoblast cell differentiation and function.

Aims and Objectives

- MicroRNA mediated regulation of trophoblast stem cell differentiation decipher the molecule(s) involved in the regulation of placental angiogenesis and their mechanism of action

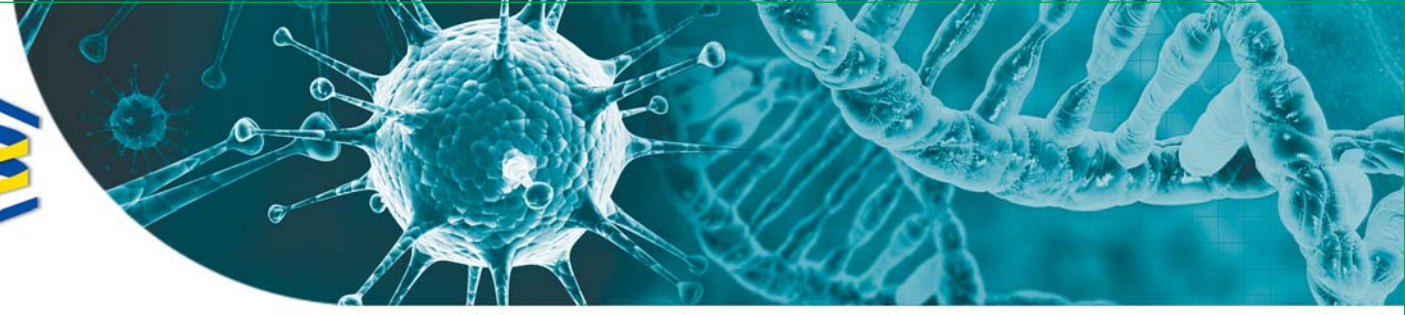
Work Achieved

MicroRNA regulation of transthyretin in trophoblast differentiation and intra-uterine growth restriction.

Placental trophoblast cells produce various cytokines, transporters vital to normal embryogenesis. Transthyretin (TTR) aids trans-placental passage of maternal thyroxin (TH) to fetal circulation. Inadequate TH delivery leads to developmental abnormality. Regulation of TTR biosynthesis in placenta is critical for normal embryo development. We showed here that TTR transcripts were expressed more in fetal side of the placenta. Using bioinformatic analysis and confirmation with dual-luciferase reporter assays, we found that miR-200a-3p and miR-141-3p inhibited TTR expression by directly binding to the 3'UTR of TTR, which is reversed by mutation in the miRNA binding site. Differentiation of human trophoblast BeWo cells was associated with decreased TTR transcript and protein levels with concomitant increase in the levels of both miRNAs. Interestingly, ectopic overexpression of the miRNA mimics abrogated thyroxin uptake by BeWo cells, which was reversed by the corresponding inhibitors. Furthermore, in a rat model of intra-uterine growth restriction (IUGR), TTR expression decreased significantly in placenta with reciprocal rise in miR-141-3p but not 200a-3p. In human IUGR placenta, TTR transcript and protein levels were significantly lower associated with high expression of miR-141-3p but not 200a-3p. These data provides new insight into physiological role of miR-141-3p in regulating TTR during trophoblast differentiation and IUGR.

Nitric-oxide synthase trafficking inducer is a pleiotropic regulator of endothelial cell function and signaling: Implications in intrauterine growth restriction.

Endothelial cell functions, including angiogenesis and vascular permeability are known to be regulated by endothelial nitric oxide synthase (eNOS) and its bioactive product nitric oxide (NO). Pharmacological inhibition or genetic disruption of eNOS attenuated angiogenesis during tissue repair, resulting in delayed wound closure, which was reversed by addition of NO donors. VEGF mediated angiogenesis is inhibited upon reduction of NO bioactivity both in vitro and in vivo. These observations emphasize the ability of eNOS-derived NO to promote angiogenesis. NOSTRIN is classically known to sequester eNOS, thereby attenuating NO production. We show here that NOSTRIN affects endothelial cells by down regulating several genes, related to invasion and angiogenesis. Interestingly, this effect of NOSTRIN on endothelial cell gene expression is independent of eNOS activity. NOSTRIN also affects the expression of secreted cytokines involved in inflammatory responses. Ectopic over-expression of NOSTRIN is inhibitory to endothelial cell proliferation, migration, invasion,



VEGF-induced capillary tube formation as well as adhesion. Furthermore, NOSTRIN directly interacts with TRAF6 and inhibits NFκB activity. Interestingly, TNF-α induced NFκB pathway activation is overturned by NOSTRIN. These results have widespread biological implications as over expression of NOSTRIN leading to down regulation of NFκB pathway and consequent triggering anti-angiogenic cascade might inhibit tumorigeneis and cancer progression as well as in patho-physiological conditions such as intra-uterine growth restriction (IUGR). IUGR is the second leading cause of peri-natal mortality and 40% of total still-births world-wide is contributed by IUGR. Interestingly, there was massive up regulation of NOSTRIN transcript as well as protein in the mesometrial compartment of implantation site in the IUGR rats as compared to the controls. NOSTRIN up regulation was associated with down regulation in mesometrial compartment of angiogenesis and invasion related genes that are known to be regulated by NOSTRIN. These include receptor tyrosine kinases, and a pro-angiogenic ligand, adhesion molecules, proteases. Furthermore, NOSTRIN elevation during IUGR was also associated with down regulation of several cytokines, such as, IL6, Ccl2, Cxcl1 and Cxcl2 in the mesometrial uterus. As expected, elevated levels of NOSTRIN was associated with down regulation of NFκB signalling pathway. In line with its up regulation in IUGR, NOSTRIN was found to be negatively regulated by HIF1α and HIF-1α decreased significantly in the mesometrial uterus in IUGR. Taken together, our data establish cellular function of NOSTRIN and demonstrate the involvement of NOSTRIN-NFκB signalling pathway in IUGR.

Future Research Plans

- Identify miRNAs and their regulatory gene network that governs trophoblast stem cell self-renewal and impart their invasive phenotype upon differentiation.
- Elucidate the transcptional regulation of NOSTRIN in endothelial and trophoblast cells. Illustrate the consequences of CRISPR-Cas9 mediated deletion of NOSTRIN gene in differentiating trophoblast cells in terms of affecting trophoblast cell function.

PUBLICATIONS

Chakraborty S. and Ain R. (2017) Nitric-oxide synthase trafficking inducer is a pleiotropic regulator of endothelial cell function and signaling. *J Biol Chem.* **292(16):**6600-6620.

Joshi R., Quadros R., Drumm M., Ain R. and Panicker M. (2017) Sedative effect of Clozapine is a function of 5-HT2A and environmental novelty. *Eur Neuropsychopharmacol.* **27(1):**70-81.

AWARDS / HONOURS / MEMBERSHIPS

Memberships

Indian Society for Study of Reproduction and Fertility (ISSRF)

American Society for Biochemistry and Molecular Biology (ASBMB)

Student's Awards

Shreeta Chakraborty

ASBMB 2017 Graduate/Postdoctoral Travel Award.

DBT- Travel Support for attending International Conference/ Seminar/ Symposium (DBT/CTEP/02/201700093).

CMR-International Travel Grant for Non ICMR scientists [No.3/2/TG-78/HRD-2016 (12)]

EXTRAMURAL FUNDING

Studies on trophoblast and natural killer cell interaction at the maternal-fetal interface. 2013-2016 (Department of Science and Technology, India)

Transgenic Over-Expression of NOSIP in Mice and Pregnancy-Induced Hypertension. 2014-2016 (Department of Biotechnology, India)

Transgenic Over-Expression of NOSTRIN in Mice and Pregnancy-Induced Hypertension. 2014-2019 (Indian Council of Medical Research, India)

MiRNAs in trophoblast stem cell differentiation. 2016-2019 (Department of Science and Technology, India)

CONFERENCES / WORKSHOPS

Number of abstracts

India: 2 International: 1

INVITED TALKS

A *novel NOSTRIN- TRAF6- NFκB signalling regulates pleiotropic functions of endothelial cell: implications in intra-uterine growth restriction.* 85th Annual Meeting of Society of Biological Chemists(I) on "Innovations in biological research for health, disease and environment" CSIR-CFTRI, November 2016, Mysore, India.

Dr. Partha Chakrabarti

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Unraveling a novel mechanism of dipeptidyl peptidase-4 (DPP4) shedding in type 2 diabetes

Participants

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Technical Officer: Dipika Ra

DST-INSPIRE Faculty: Md Wasin Khan

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ILS hospital, Kolkata

Collaborators within CSIR-IICB

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Structural Biology& Bioinformatics Division

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Cancer Biology & Inflammatory Disorder Division

Dr. P Jaishankar and Dr. Sanjay Dutta
Organic & Medicinal Chemistry

Background

Gut-derived incretin hormones glucagon-like peptide (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP) directly activate insulin secretion via binding to their distinct receptors on the pancreatic islet β-cells. Blunted first phase insulin secretion, attributed mainly to GLP-1 deficiency but also partly to GIP resistance is intimately linked to T2DM. The ubiquitously expressed negative regulator of incretin hormones, DPP4 exists either as a single pass type II transmembrane protein or as shedded soluble form of serine protease that hydrolyzes proline or alanine from the N-terminus of different polypeptides including incretin hormones.ÊPlasma levels and activity of DPP4 has been found to be associated with progression of metabolic syndrome. Nevertheless the reason behind this increase in plasma DPP4 activity in T2DM patients and the cellular source and mechanism of DPP4 shedding into plasma remain largely unaddressed.

T2DM, insulin resistance and associated clinical outcomes of metabolic syndrome are causally related to low grade chronic systemic inflammation, or metaflammtion, in metabolically active tissues.Ê Recruitment and activation of plethora of immune cells, such as macrophage, conventional dendritic cells, T cells, in the metabolically active tissues including pancreas, adipose and liver is well documented in patients as well as animal models of the disease. Immune cell homing in specific organs leads to obesity associated deregulated metabolic outcome and inflammatory cytokines secreted from immune cell regulate metabolic homeostasis and insulin resistance. Interestingly, DPP4 is expressed in subset of circulating immune cells, especially T cells where both the membrane bound as well as soluble DPP4 have been described as co-stimulatory molecules for T cell activation often via interactions with adenosine deaminase. Moreover, it was shown that DPP4 level on T cells was increased in T2DM patients and it is linked with long term glycemic control. Of note here, among various T cells subsets, DPP4 expression is maximum in IL-17 producing CD4+ T cells (Th17 cells) which are one of the major participants of inflammation in obesity associated T2DM.

Aims and Objectives

- Primary aim of this project is to investigate the role of circulating immune cells, specifically the Th17 cells, as the major source of plasma DPP4 abundance and activity in T2DM patients and explored the possible mechanisms that leads to release of soluble DPP4 in plasma of these patients.

Work Achieved

We looked into the source of plasma DPP4 activity in a cohort of treatment naive T2DM patients, having significantly higher plasma DPP4 activity than the healthy controls. Circulating immune cells particularly CD4+ T cells served as an important source for the increase in plasma DPP4 activity. Moreover, we found kallikrein-related peptidase 5 (KLK5) as the enzyme responsible for cleaving DPP4 from the surface of circulating CD4+ Th17 cells and shedding them into the plasma of persons

with T2DM. Similar cleavage and shedding activities were not seen in controls. Our study also provides mechanistic insights into the molecular interaction between KLK5 and DPP4 and CD4+ T cell derived KLK5 mediated enzymatic cleavage of DPP4 from cell surface, opening up the possibility of developing novel therapeutic strategies targeting this pathway. Thus our study uncovers hitherto unknown cellular source and mechanism behind enhanced plasma DPP4 activity in T2DM.

Future Research Plans

Pre-clinical validation of patient based results in the progression of T2DM by genetic manipulation of KLK5

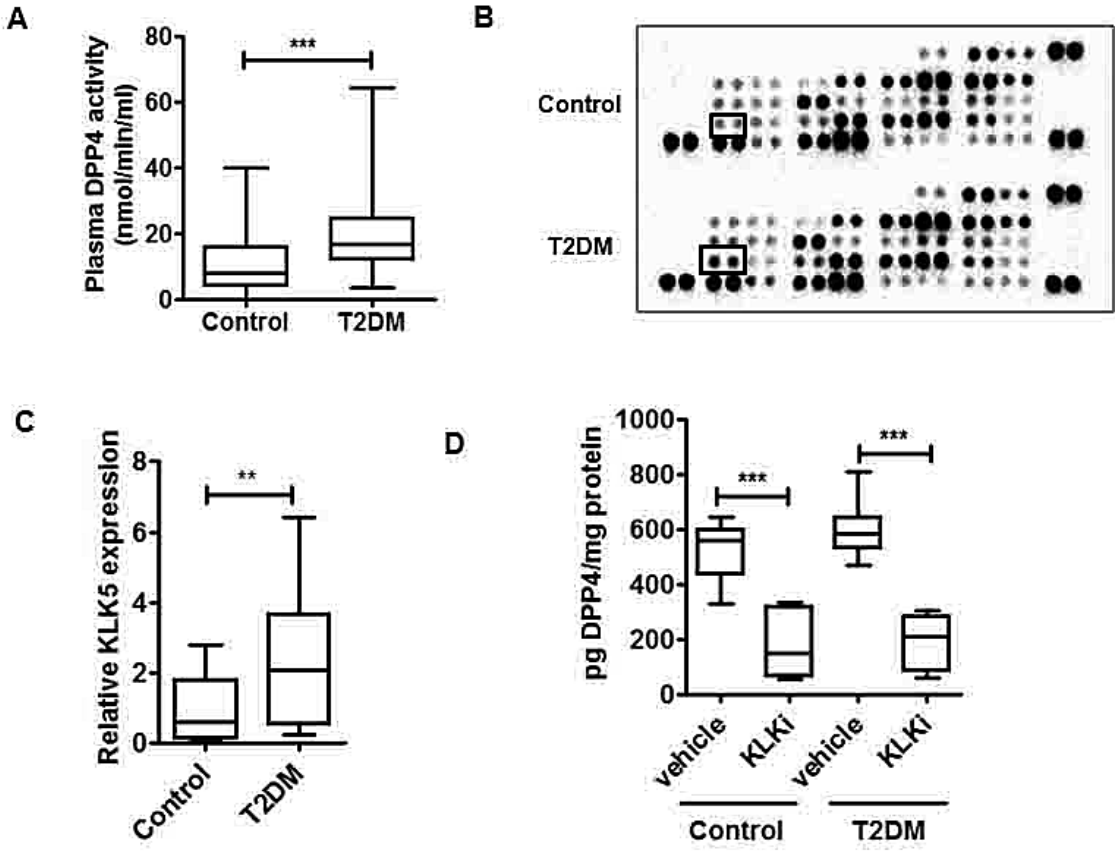

Fig. 1: KLK5 is the proteolytic enzymes involved in the DPP4 shedding from PBMC. (A) DPP4 activity in plasma of treatment naïve type 2 diabetic (T2DM) patients in related to healthy control (control n=78 & T2DM n=135). (B) PBMC were obtained from T2DM patients and healthy control and cultured for 48h in RPMI media with 10% FBS. Culture supernatants were pooled (n=8) and human protease array profile was performed. Spots for KLK5 are marked. (C) Comparison of PBMC KLK5 gene expression in T2DM and control population (control n=17 & T2DM n=20). (D) PBMC was incubated for 16h with 100µg/ml KLK inhibitor (KLKi; control n=6 and T2DM n=12). DPP4 release in the culture supernatants were measured by ELISA. Statistical analysis were calculated by Mann-Whitney U test and shown as box plots; p**<0.01, ***p<0.001.

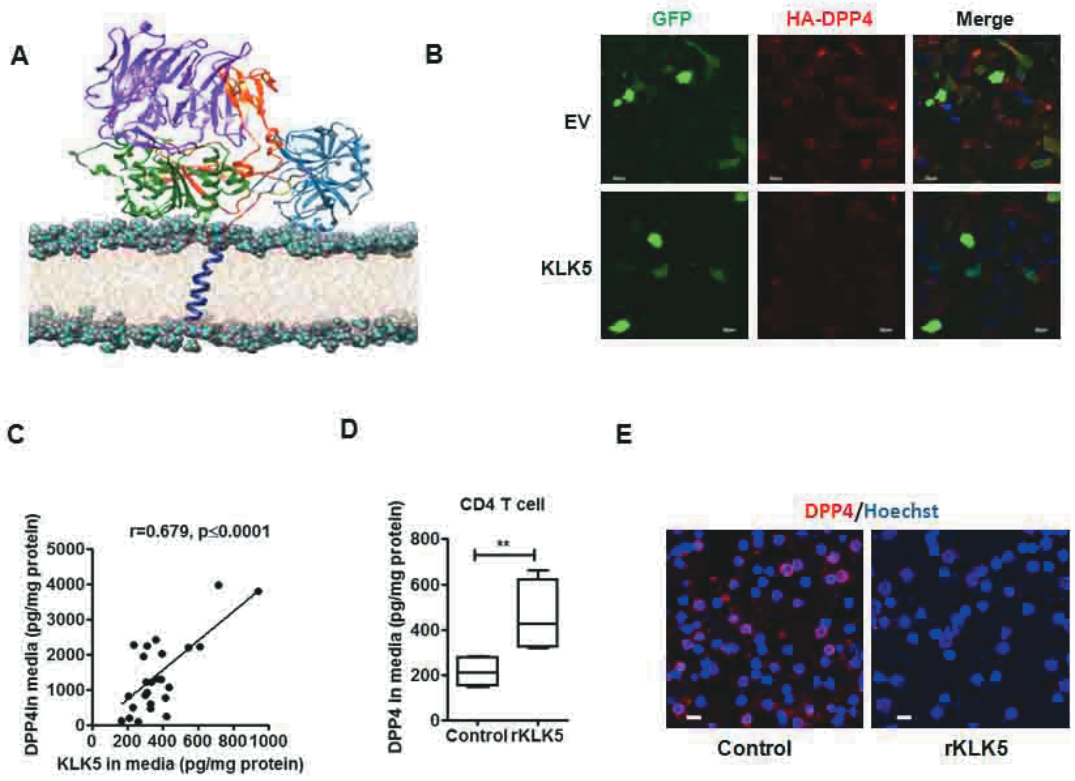

Fig. 2: KLK5 cleaves DPP4 from cell surface through direct interaction. (A) Three-dimensional model structure of the full length DPP4 protein where DPPIV_N domain is marked in purple, Peptidase_S9 domain in green and linker domain in orange, respectively. The transmembrane (TM) region is marked in blue, embedded in POPC bilayer. Left side shows the initial structure (0th ns) whereas end structure (100th ns) of the 100 ns molecular dynamics simulation is shown in right. (B) Fluorescence confocal microscopy images of the stable HA-DPP4 expressing HepG2 cells co-transfected with 2 µg KLK5 and 200 ng GFP plasmid. A constitutive GFP-expressing vector served as a transfection control. Membrane bound DPP4 expression was detected with anti-HA antibody (red) at 40 h post-transfection. Scale bar = 20 µm. (C) Comparison of relative gene expression in CD4+T cells for DPP4 and KLK5 in T2DM and control population (control n=18 & T2DM n=27). (D) Isolated CD4+T cells were incubated with anti-CD3 and anti-CD28 antibodies for 48 h and secreted DPP4 as well as KLK5 protein were measured by ELISA (control n=12 & T2DM n=27). Linear regression analysis of secreted DPP4 protein with secreted KLK5 protein in overall population. (E) Anti-CD3 and anti-CD28 activated CD4+T cells were cultured in a polylysine coated plate for 16 h. Then cells were fixed with 4% PFA and stained with rabbit anti-human DPP4 mAb followed by Alexa Fluor 546 goat anti-rabbit antibody (red). Finally cells were visualized with fluorescence confocal microscopy. Scale bar = 10 µm.

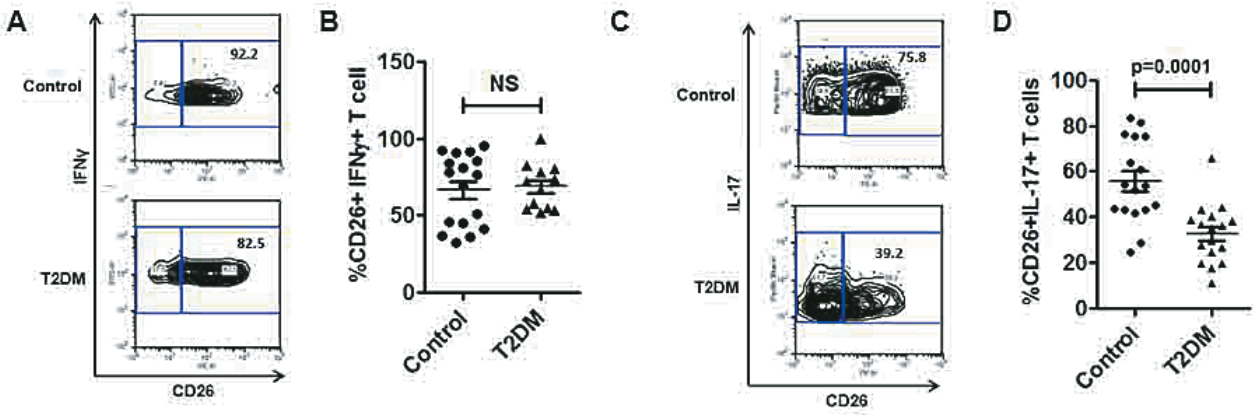

Fig. 3: Decreased surface expression of DPP4 in Th17 cells of T2DM patients. (A-B) (A, B) CD3/CD28 stimulated CD4+T cells were incubated with inomycin, PMA and brefeldin before flow cytometric analysis (control n= 17 & T2DM n= 12). Representative flow plots for IFNγ and CD26 staining (A) and the summary (B) of all the analyzed samples are shown. (C, D) IL-17A cytokine staining with surface expression of CD26 from healthy control (n=20) and treatment naïve T2DM (n=19) were determined by flow cytometry.p value was calculated by Mann-Whitney U test.

PUBLICATIONS

Basu M., Khan M.W., Chakrabarti P., Das C. (2017) Chromatin reader ZMYND8 is a key target of all trans retinoic acid-mediated inhibition of cancer cell proliferation. *Biochimica et biophysica acta (BBA) - Gene Regulatory mechanisms.* **1860,** 450–459

Ghosh M., Niyogi S., Bhattacharyya M., Adak M., Nayak D.K., Chakrabarti S., Chakrabarti P. (2016) Ubiquitin ligase copl controls hepatic fat metabolism by targeting at gl for degradation. *Diabetes.* **65,** 3561-3572

Ghosh A.R., Bhattacharya R., Bhattacharya S., Nargis T., Rahaman O., Duttagupta P., Raychaudhuri D., Chen Liu C.S., Roy S., Ghosh P., Khanna S., Chaudhuri T., Tantia O., Haak S., Bandyopadhyay S., Mukhopadhyay S., Chakrabarti P., Ganguly D. (2016) Adipose recruitment and activation of plasmacytoid dendritic cells fuel metaflammation. *Diabetes.* **65,** 3440-3452.

Biswas D., Ghosh M., Kumar S., Chakrabarti P. (2016) PPARα-ATGL pathway improves muscle mitochondrial metabolism: implication in aging. *FASEB J.* **30,** 3822-3834

AWARDS / HONOURS / MEMBERSHIPS

Students

Titli Nargis

Awards

DBT travel fellowship for attending Keystone Symposium at Copenhagen, Denmark

Infectious Diseases and Immunology Division

Dr. Nahid Ali (Head upto July 2016), Dr. Rukhsana Chowdhury (Head), Dr. Rupak K. Bhadra, Dr. Uday Bandyopadhyay, Dr. Subhajit Biswas and Dr. Mita Chatterjee Debnath

The major objectives of Infectious Diseases and Immunology Division are a) elucidation of the molecular mechanisms of pathogenesis associated with cholera, leishmaniasis, malaria, hepatitis B virus infections, ulcers and gastropathy, b) development of diagnostic and therapeutic measures for these diseases, and c) evaluation of radioisotopes for biological applications.

Work on cholera involves (i) studies on the effect of host interaction on virulence, biofilm formation and antibiotic resistance in *Vibrio cholerae,* (ii) elucidation of stringent response regulatory circuits in *V. cholerae* and its role in modulation of various virulence traits like motility, cholera toxin production, HA protease production and biofilm formation. Another gastrointestinal pathogen *Helicobacter pylori* has also been studied with special emphasis on host pathogen interaction and assessment of the role of gastric microbiome in determining clinical outcome of *H. pylori* infection. Malaria and gastropathy work is focussed on (i) characterization of *Plasmodium falciparum* vacuolar protein sorting, (ii) development of anti-malarial small molecule therapeutics, (iii) a novel gastroprotective mechanism independent of gastric acid suppression, (iv) demonstration of the effects of Ellagic Acid, a Dietary Polyphenol, on Human Macrophage Migration Inhibitory Factor and (v) preparation and use of Tryptamine derivatives in gastropathy. Work on leishmaniasis is comprised of (i) development of a simple, non-invasive and effective diagnostic approach, (ii) comprehensive assessment of liposome-encapsulated drugs as therapeutic agent as well as designing antileishmanial treatment strategies by altering lipid composition of host cell membrane, (iii) studies on the immunobiology of leishmaniasis towards identifying potential vaccine candidates and (iv) functional analysis of antigen presentation and antigen processing in *Leishmania* infected antigen presenting cells.

Work on hepatitis B virus infections includes (i) studies on epidemiology of occult hepatitis B infection (OBI) (ii) elucidation of hepatitis B virus S protein (wild type & mutants) in intracellular morphogenesis and trafficking in hepatocytes, and (iii) characterization of prevalent S protein mutations responsible for “immune escape” or excretion defect thereby contributing to OBI genesis. Work has also been done on development of ^{99m}Tc -labeled receptor specific peptides and amino acids and lipid carriers coupled to bioactive pharmacophores (nucleoside analogs and drug loaded nanoparticles) to be used as potential radiopharmaceuticals for scintigraphic diagnosis and therapy.

Dr. Rukhsana Chowdhury

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Host contact dependent virulence regulation in the gastrointestinal pathogens Vibrio cholerae and Helicobacter pylori

Participants

SRF: Chirantana Sengupta, Saurabh Bhattacharya

Project Associate: Ronita De, Oindrilla Mukherjee

WOS Sonia Jain

Collaborator(s)

Collaborators outside CSIR-IICB

Dr. Saumya Raychoudhuri
IMTECH, Chandigarh

Dr. Prakash Chandra Mandal
Appollo Glneagles Hospital, Kolkata.

Collaborators within CSIR-IICB

Dr. Chitra Dutta & Dr. Sandip Paul
Structural Biology & Bioinformatics Division

Dr. Snehasikta Swarnakar
Cancer Biology& Inflammatory Disorder Division

Background

Adherence of non invasive pathogens to host cells is of primary importance in host-pathogen interaction leading to disease. Bacterial genes specifically induced following adherence of the bacterial pathogens to host cells and the function of these gene products, especially with reference to virulence, has been investigated in *Vibrio cholerae* and *Helicobacter pylori*.

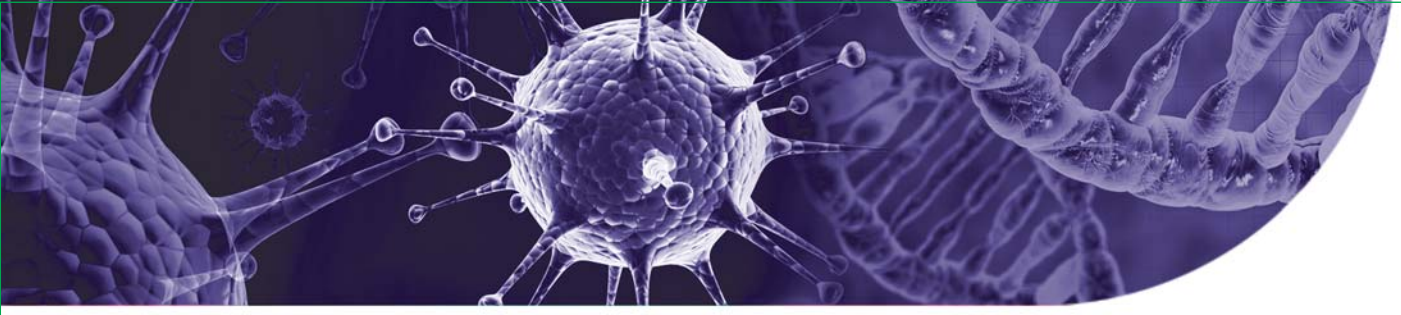
Aims and Objectives

- Role of *H. pylori gene HP0102 in host interaction and pathogenesis*
- Host cell contact induced *V. cholerae* biofilm regulatory genes and biofilm formation on intestinal cells
- Alteration of oral microbiota composition in tobacco chewing associated oral cancer

Work Achieved

Host cell contact induces biofilm formation and antibiotic resistance in Vibrio cholerae

Vibrio cholerae is known to form biofilms for persistence in the environment. We have demonstarted that even during infection, biofilm genes are upregulated and microscopic observation indicated that biofilm formation is initiated almost immediately after adherence of *V. cholerae* to intestinal cells and also during infection in animal models. About 7 fold upregulation of the biofilm regulatory gene *vpsT* was observed within 30 minutes of adherence of *V. cholerae* to the intestinal cell line INT 407 and a massive induction of about 700 fold was observed in rabbit ileal loops. The upregulation was observed in the classical and El Tor biotype strains of serogroup O1 that is most frequently associated with epidemic cholera. *vpsT* upregulation was primarily dependent on the virulence master regulator AphA. Of possible clinical relevance was the observation that *V. cholerae* in the INT 407 associated biofilms was significantly more resistant to antibiotics than unadhered planktonic cells.



Multiple roles of a H. pylori gene HP0102 in pathogenicity

Adherence of *H. pylori* to the gastric epithelial cell line AGS strongly upregulated expression of a gene HP0102 in the adhered bacteria in all *H. pylori* strains examined, including several Indian clinical isolates. The gene is associated with several distinct phenotypes related to pathogenecity, a) upregulation of the major virulence gene *cagA* following adherence of *H. pylori* to gastric cells and consequent induction of elongation and scattering of the infected gastric cells, b) chemotaxis and acid escape response, and c) cytokine and chemokine induction in gastric cells following *H. pylori* adherence.

Role of oral microbiome in determining clinical outcome of tobacco chewing

Metagenomic sequencing of 16SrDNA from saliva samples collected from individuals with or without tobacco chewing habits and precancerous or cancerous lesions was performed. In case of oral cancer samples with tobacco chewing habit, the overall microbial community structure has been found to be significantly different from normal samples. Although, the cancer patients have addiction towards different kinds of tobacco chewing habits (khaini, guthkha, gurakhu etc.) the overall microbial community structure is almost similar. Thus for cancer subjects specific microbial community structure exists and that is quite different from normal healthy samples. Further bioinformatic analysis is in progress.

Future Research Plans

Development of microbiome based non invasive prognostic measures for oral cancer risk assessment in individuals with tobacco chewing and other oral habits

PUBLICATIONS

Sengupta C., Mukherjee O. and Chowdhury R. (2016) Adherence to intestinal cells promotes biofilm formation in Vibrio cholerae. *J Infect Dis* **214,** 1571-1578

Bhattacharya S., Mukherjee O., Mukhopadhyay A.K. and Chowdhury R. (2016) A conserved helicobacter pylori gene, hp0102, is induced upon contact with gastric cells and has multiple roles in pathogenicity. *J Infect Dis* **214,** 196-204

Sengupta C., Ekka M., Arora S., Dhaware P.D., Chowdhury R. and Raychaudhuri S. (2017) Cross feeding of glucose metabolism byproducts of Escherichia coli human gut isolates and probiotic strains affect survival of Vibrio cholerae. *Gut Pathog* **9,** 3

CONFERENCES / WORKSHOPS

Number of abstracts

India: 1

Dr. Rupak K. Bhadra

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Molecular dissection of the regulatory mechanisms under nutritional and other stresses in *Vibrio cholerae*

Participants

SRF: Pallabi Basu, Dipayan Rakhsit, Quoelee Biswas

Research Associate: Dr. Mousumi Saha,

Project Assistant: Shib Kumar Sharma

Technician: Pratap Koyal

Collaborators

Collaborators outside CSIR-IICB

Dr. T. Ramamurthy and Amit Pal
ICMR-National Institute of Cholera & Enteric Diseases, Kolkata

Background

Microbial pathogens constantly face plethora of environmental stresses both under *in vitro* and *in vivo* conditions and they have evolved with multiple genetic circuits to combat such situations. Our group is working on the regulation of nutritional stresses using the human cholera pathogen *Vibrio cholerae* as a model system. Nutritional stress in bacteria evokes stringent response, which is a global regulatory mechanism controlling various gene regulatory circuits working towards the survival mode of the organism. Stringent response is efficiently managed by the generation of two intracellular small signaling molecules, pppGpp and ppGpp, collectively called (p)ppGpp. So far we have functionally characterized majority of the genes such as *relA, spoT, cgtA, relV, dksA* and *gppA* of *V. cholerae*, which are intricately involved in managing the stringent response of this pathogen under amino acid, glucose or fatty acid starvation. (p)ppGpp binds with the RNA polymerase (RNAP) enzyme and regulates transcription of several genes either positively or negatively so that cells can enter into survival mode as long as the stress is there. However, (p)ppGpp needs a 17.5-kDa small protein, called DksA, as a co-factor to exert its control over expression of genes. Interestingly, like (p)ppGpp, DksA also binds with the secondary channel of RNAP and thus, it is an unusual transcription factor.

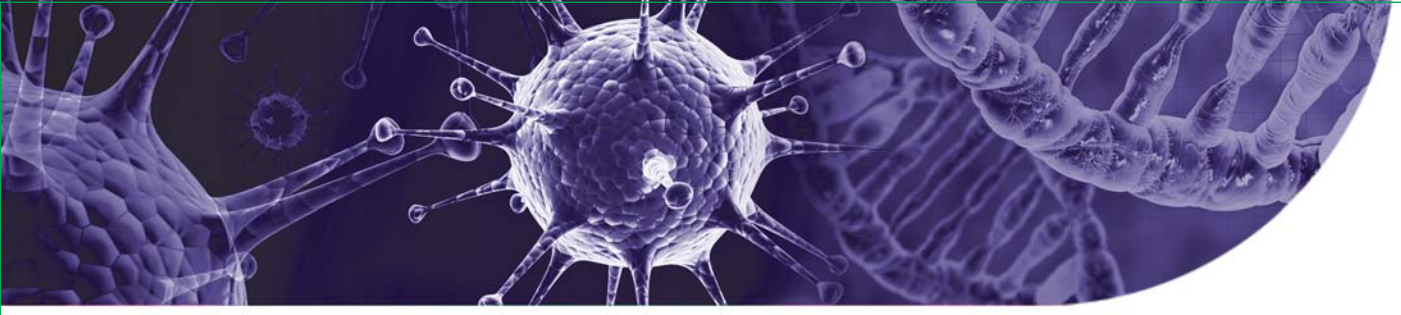
We have shown earlier that *V. cholerae* DksA somehow modulates the virulence gene expression in *V. cholerae*. At present our group is involved in deciphering the molecular mechanisms behind this observation. In the current year major efforts were given to understand the role of DksA in oxidative stress management in *V. cholerae*.

Aims and Objectives

- Role of DksA and pppGpp/ppGpp in fine regulation of virulence gene expression in *V. cholerae*
- Role of DksA in oxidative stress management in *V. cholerae*

Work Achieved

Since *V. cholerae* is an environmental water dwelling organism, in certain situations it may be exposed to hydrogen peroxide leading to severe oxidative stress. For example, UV radiation on the water surfaces generates hydrogen peroxide which may lead to cell death. Stationary phase sigma factor RpoS has previously been reported to be essential for survival of *V. cholerae* under oxidative stress conditions. However, the question arises whether the transcription factor DksA of *V. cholerae* ($DksA_{Vc}$) plays a role during such stressful situations. Moreover, $DksA_{Vc}$ has been shown to play a role in the positive regulation of RpoS in *V. cholerae* (Basu *et al.,* Microbiology, 2017; doi: 10.1099/mic.0.000469). Interestingly, recently we observed that *V. cholerae* $\Delta dksA_{Vc}$ mutant is susceptible to oxidative stress. *V. cholerae* carries two catalase genes, *katG* and *katB,* the products of which may help in breaking down hydrogen peroxide produced as a result of UV radiation on the water surfaces. qRT-PCR analysis revealed that *katG* is maximally induced during the stationary phase of growth while *katB* expression remained more or less same in all growth phases. Since RpoS controls several genes during stationary phase of growth it is expected it may control *KatG* expression also. When *V. cholerae* Δ*rpoS* mutant was examined it showed significant down regulation of the *katG* but not *katB* gene. Since, $DksA_{Vc}$ is required for the positive regulation of RpoS, it was therefore imperative to determine the role of $DksA_{Vc}$ in the regulation of the catalase genes *katG*. qRT-PCR analysis revealed that the expression of *katG* is indeed substantially down regulated in $\Delta dksA_{Vc}$ cells compared to its isogenic wild-type strain. On the other hand, the *katB* gene expression



in Δ*dksA*$_{Vc}$ cells remained more or less same like that of wild-type. This result is in agreement with the result obtained in the case of the Δ*rpoS* mutant discussed above. Thus, it may be concluded that DksA$_{Vc}$ most likely regulates the catalase gene *katG* through modulation of expression of RpoS, which in turn plays an essential role in providing protection of *V. cholerae* cells against oxidative stress. The working model for regulation of oxidative stress management by DksA$_{Vc}$ is shown in **Fig. 1.**

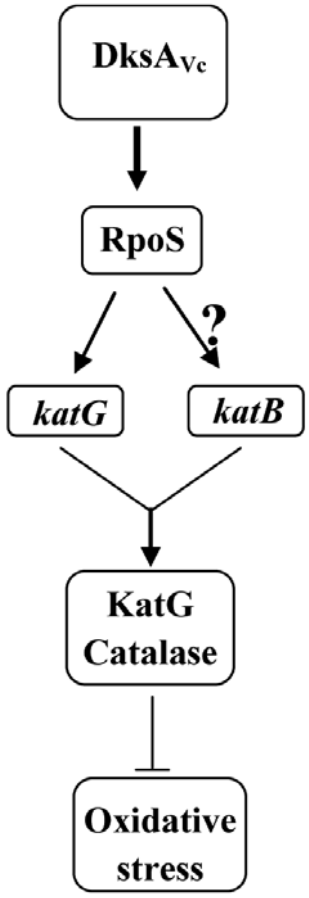


Fig. 1. Working model shows the probable regulatory role of the stringent response regulator DksA$_{Vc}$ in the management of oxidative stress in *V. cholerae* through regulation of the stationary phase sigma factor RpoS. DksA$_{Vc}$ positively regulates RpoS which in turn upregulates the expression of the major catalase KatG but probably not KatB as indicated by '?'. KatG catalase then manages to combat oxidative stress and allows cells to survive.

Future Research Plans

Further experiments are needed to establish firmly the exact role of the stringent response regulators in controlling oxidative stress in *V. cholerae*. We are also involved in functional characterization of the *V. cholerae gppA* gene, which codes for a hydrolase and it is needed to convert pppGpp to ppGpp. Apart from this project we will also work on molecular basis of antibiotic resistance in *V. cholerae* and genetic characterizations of pathogenicity island genes of *V. cholerae* non-O1/non-O139 strains.

Publications

Chowdhury G., Bhadra R.K., Bag S., Pazhani G.P., Das B., Basu P., Nagamani K., Nandy R.K., Mukhopadyay A.K and Ramamurthy T. (2016) Rugose atypical *Vibrio cholerae* O1 El Tor responsible for 2009 cholera outbreak in India. *J Med Microbiol* **65,** 1130-1136.

Ghosh R., Sharma N.C., Halder K., Bhadra R.K., Chowdhury G., Pazhani G.P., Shinoda S., Mukhopadhyay A.K., Nair G.B. and Ramamurthy T. (2016) Phenotypic and genetic Heterogeneity in *Vibrio cholerae* O139 isolated from cholera cases in Delhi, India during 2001-2006. *Front Microbiol* **7,** 1250.

Tapader R., Bose D., Basu P., Mondal M., Mondal A., Chatterjee N.S., Dutta P., Basu S., Bhadra R.K. and Pal A. (2016) Role in proinflammatory response of YghJ, a secreted metalloprotease from neonatal septicemic *Escherichia coli*. *Int J Med Microbiol* **306,** 554-565.

EXTRAMURAL FUNDING

Rupak K. Bhadra (PI), Dr. Pijush K. Das (Co-PI)

Targeting deadenilation mediated Kinetoplastidae parasite-specific polycystronic gene regulation for therapeutic intervention

13 May, 2016 – 12 May, 2019 (Department of Biotechnology, Government of India, India)

CONFERENCES / WORKSHOPS

Number of abstracts

International: 1

AWARDS / HONOURS / MEMBERSHIPS

Elected fellow of the National Academy of Sciences (NASI), India, December 2016.

Dr. Uday Bandyopadhyay
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Antimalarial activity of small molecule benzothiazole hydrazones

Participants

JRF: Subhashis Deasharma, Debanjan Saha

SRF: Rudranil De, Shubhra J. Saha, Shiladitya Nag

Collaborator(s)

Collaborators outside CSIR-IICB

Dr. Susanta Adhikari
Department of Chemistry, University of Calcutta, 92, A. P. C. Road, Kolkata 700 009, West Bengal, India

Dr. Kaushik Biswas
Division of Molecular Medicine, Bose Institute, 93/1, Acharya Prafulla Chandra Road, Kolkata-700 009, West Bengal, India.
ICMR-National Institute of Cholera & Enteric Diseases, Kolkata

Background

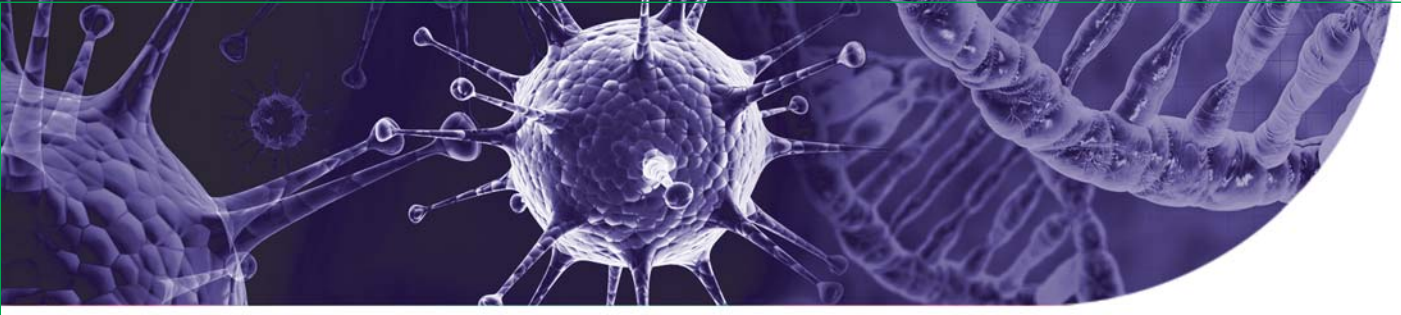
P. falciparum is the deadliest among the Plasmodium species that causes malaria in human. With an alarming increase in the emergence of drug resistant parasites especially the MDR strains, established antimalarials have become more and more ineffective thereby instigating active exploration for developing newer substitutes to confront the disease. In this regard new generation of in vivo active antimalarials are the need of time.

Aims and Objectives

- Identification and designing of anti-malarial molecule targeting heme polymerization
- Structure-activity relationship studies of the identified heme-polymerization inhibitor

Work Achieved

We synthesized a new series of conjugated hydrazones that were found to be active against malaria parasite *in vitro* as well as *in vivo* in murine model. These hydrazones concentration-dependently chelated free iron and offered antimalarial activity against *Plasmodium falciparum.* Upon screening of the synthesized hydrazones, compound 5f was found to be the most active iron chelator as well as antiplasmodial. Iron (Fe(III)) chelating activity of compound 5f was further evaluated by complex formation and subsequent identification by infrared spectroscopy. Compound 5f efficiently interacted with free heme (K_D = 1.17 ± 0.8 μM), an iron containing tetrapyrrole released after hemoglobin digestion in food vacuole of parasite and also inhibited heme polymerisation by parasite lysate *in vitro.* Structure activity relationship studies indicated that nitrogen and sulphur substituted five membered aromatic ring present within the benzothiazole hydrazones might be responsible for their antimalarial activity. The dose-dependent antimalarial and heme polymerization inhibitory activities of the lead compound 5f were further validated by following [^{3}H]-hypoxanthine incorporation and hemozoin formation in parasite respectively. We evaluated in vivo antimalarial activity of compound 5f in murine model where a lethal multiple drug resistant (MDR) strain *Plasmodium yoelii* was used to infect Swiss albino mice. Compound 5f significantly



suppressed the growth of parasite and the infected mice experienced longer life span upon treatment with this compound. During *in vitro* and *in vivo* toxicity assays, compound 5f showed minimal alteration in biochemical and hematological parameters compared to control. In conclusion, we identified a new class of hydrazone with therapeutic potential against malaria.

Future Research Plans

Synthesis and bio-evaluation of antimalarial small molecules.

PUBLICATIONS

Sarkar S., Siddiqui A.A., Saha S.J., De R., Mazumder S., Banerjee C., Iqbal M.S., Nag S., Adhikari S. and Bandyopadhyay U. (2016) Antimalarial activity of small-molecule benzothiazole hydrazones. *Antimicrob Agents Chemother* **60,** 4217-4228

Mazumder S., De R., Sarkar S., Siddiqui A.A., Saha S.J., Banerjee C., Iqbal M.S., Nag S., Debsharma S. and Bandyopadhyay U. (2016) Selective scavenging of intra-mitochondrial superoxide corrects diclofenac-induced mitochondrial dysfunction and gastric injury: A novel gastroprotective mechanism independent of gastric acid suppression. *Biochem Pharmacol* **121,** 33-51

Goyal M., Banerjee C., Nag S. and Bandyopadhyay U. (2016) The Alba protein family: Structure and function. *Biochim Biophys Acta* **1864,** 570-583

Sarkar S., Mazumder S., Saha S.J. and Bandyopadhyay U. (2016) Management of inflammation by natural polyphenols: a comprehensive mechanistic update. *Curr Med Chem* **23,** 1657-1695

AWARDS / HONOURS / MEMBERSHIPS

Dr. Uday Bandyopadhyay

Platinum Jubilee lecture Award from 104th Indian Science Congress, 3-7 January, 2017 SV University, Tirupati.

Memberships

Life Member of Indian Science Congress association (ISCA) (Membership No: L30077).

Council Member of West Bengal Academy of Science and Technology (WAST), 2017 Nil

EXTRAMURAL FUNDING

An insight into the role and regulation of mitochondrial innermembrane uncoupling protein 2 in manipulating host-conducive oxidant-derived macrophage defense mechanism. 2015-2018 (Science and Engineering board, DST, India)

JC Bose Fellowship. 2015-2020 (Science and Engineering Research Board, DST, India)

CONFERENCES / WORKSHOPS

Chairperson, Session IV, Indo-Brazil Symposium on Parasite, September 20, 2016, CSIR-Indian Institute of Chemical Biology, Kolkata

Chairperson for the special invited lectures, International Meeting on Neurodegenerative Disorders: Current and Future Perspective. Co-hosted by Centre with Potential for Excellence in Particular Area (CPEPA), University of Calcutta, Institute of Neurosciences, Kolkata and Institute of Neurosciences, Newcastle, Upon Tyne, UK. February 10-12, 2017

INVITED TALKS

Prevention of mitochondrial pathology and redox imbalance in gastric mucosal cell is a novel therapeutic approach against non-steroidal anti-inflammatory drug-induced gastric injury. 3rd International Conference on Perspectives of Cell Signaling and Molecular Medicine.
Bose Institute . 9th January, 2017, Kolkata. India.

Non-steroidal anti-inflammatory drugs (NSAIDs)-induced gastric injury/gastropathy: cause and correction: Platinum Jubilee Lecture in the Section of Medical Sciences (including Physiology) at the 104th Indian Science Congress, SV University. 5th January, 2017, Tirupati. India.

Dr. Subhajit Biswas

subhajit.biswas@iicb.res.in

Epidemiology and molecular characterization of hepatitis B virus (HBV) infections especially occult HBV infections (OBIs) in India

Participant

JRF:Subrata Roy

Background

OBI is defined as low level of HBV DNA in the liver or blood plasma with **undetectable** HBV surface antigen (HBsAg, the antigenic part of HBV structural proteins) outside the sero-conversion window period. OBIs have been mostly reported from asymptomatic carriers. Therefore, the risk of blood transfusion from OBI donors needs to be properly evaluated especially in context of developing countries like India as the incidence of OBI is on the rise and donors' blood is commonly screened only for HBsAg. Significant research is warranted to determine the molecular aetiology and develop detail understanding of the pathogenesis of OBI in the context of the Indian sub-continent.

Aims and Objectives

1. Study the epidemiology of OBI in healthy volunteers and patients presenting with skin diseases such as *pityriasis rosea* (PR) to see if underlying cryptic HBV infections have bearing with externally visible autoimmune manifestations.
2. Elucidate hepatitis B virus S protein (wild type & mutants) intracellular morphogenesis and trafficking in hepatocytes.
3. Identify and characterize prevalent S protein mutations responsible for "immune escape" or excretion defect thereby contributing to OBI genesis.

Work Achieved

Approximately 80% of PR patients presented the evidence of underlying HBV infection (genotype D2), suggestive of horizontal HBV transmission. This warrants for mass HBV vaccination. PR patients should be tested for underlying virus infections for appropriate therapy and management.

For the first time, there is molecular genetic evidence that Indian PR cases are often associated with human herpesvirus 7 and/or HBV infections. PR?associated HBV infections are mostly OBI in nature.

Future Research Plans

Develop strategy of rapid identification/molecular characterization and management of OBI cases.

PUBLICATIONS

Das P., Khowala S. and Biswas S. (2016). *In vitro* probiotic characterization of *Lactobacillus casei* isolated from marine samples. *LWT - Food Science and Technology,* **73,** 383-390.

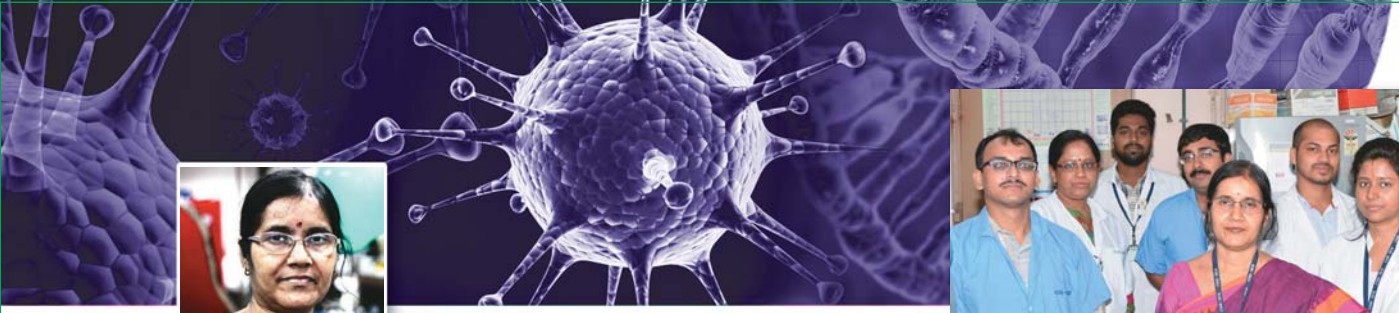
EXTRAMURAL FUNDING

Early Carrer Grant from SERB, DST, India to Dr. Biswas

Title of the project: Molecular epidemiology and characterization of occult hepatitis B virus (HBV) infections, particularly the role of S protein mutations leading to undetectable HBV surface antigen (HBsAg) in patient blood plasma.

INVITED TALK

On viruses; Popular lecture in Bangla, 61st CSIR-IICB Foundation Day, CSIR-IICB, Kolkata, April 4, 2017.



Dr. Mita Chatterjee Debnath

mitacd@iicb.res.in

Fabrication and radiolabeling of nanoparticulated drug delivery systems for radiodiagnostic and therapeutic application.

Participants

JRF: Brahamacharry Paul Kazi Julekha

SRF: Dipak kumar Nayak, Soumya Ganguly, Raghuvir Gaonkar, Ria Mukhopadhyay (DST; Inspire)

RA: Dr. Kakali De

Project Assistant: Ramkrishna Sen

Collaborator(s)

Collaborators outside CSIR-IICB

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Background

The radionuclide technetium enjoys wide spread applications in clinical nuclear medicine laboratories due to its easy availability from commercial generator columns, ideal nuclear properties, and suitable decay characteristics. Technetium-99m (^{99m}Tc)-based radiopharmaceuticals are used routinely in nuclear medicine for the diagnosis of diseases such as cancer, inflammation, infection, myocardial infarction and others This laboratory has made significant effort towards the development of ^{99m}Tc -labeled receptor specific peptides and amino acids and lipid carriers coupled to bioactive pharmacophores (nucleoside analogs and drug loaded nanoparticles) to be used as potential radiopharmaceuticals for scintigraphic diagnosis and therapy.

Aims and Objectives

- In this study main emphasis will be given to produce ^{99m}Tc(CO)$_3$-labeled receptor specific biomolecules through molecular target approach which can enable non invasive diagnosis and the pharmacophore without label could be used for therapy. The biomolecules include small linear peptides and amino acids, will acts as bifunctional chelating ligands. one end of which will accommodate technetium and other ends will be coupled to nanoparticulated drug delivery system and nucleoside analogs and will act as biovector for tissue targeting.

Work Achieved

The potentiality of the ^{99m}Tc labeled pharmacophores to diagnose and combat oxidative hepatocellular degeneration has been evaluated by biodistribution and scintigraphic experiments in hepato degenerative animal model.

Ursolic acid loaded nanoparticles revealed pronounced cytotoxic effect (MTT assay) and substantial cellular uptake in melanoma cell line (B16F10) ascertained by flow cytometric and confocal microscopyic analysis. However the evaluation of biological performance of the formulation is highly challenging. Targetibility of the nanoformulation in melanoma bearing animal model was verified by scintigraphic analysis under gamma camera by 99mTc-radiolabeling.

Pharmacokinetic studies of lipid nanocarrier based formulation exhibited enough potentiality to cross blood brain barrier (BBB). This has been ascertained by ^{99m}Tc- radiolabeling. Scintigraphic images **(Fig 2)** exhibited brain accumulation in time dependent manner. This provide a promising platform for noninvasive diagnosis of brain damage and treatment .

Future Research Plans

Evaluation of ^{99m}Tc(CO)$_3$-labeled folate receptor specific linear peptides and amino acids as bifunctional chelating agent to be used as a novel vector for targeting nucleoside analogs and nanoparticulated drug delivery systems to FR-specific site is in progress.

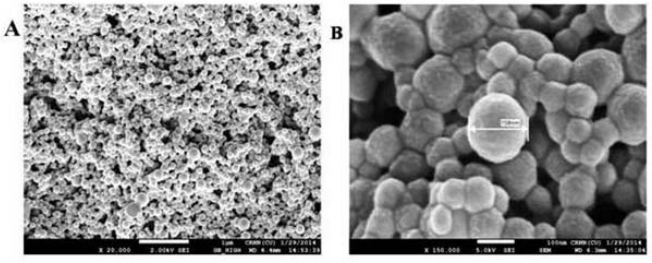

Fig. 1: FESEM photographs of nanoparticulated formulation taken from different portion of samples.

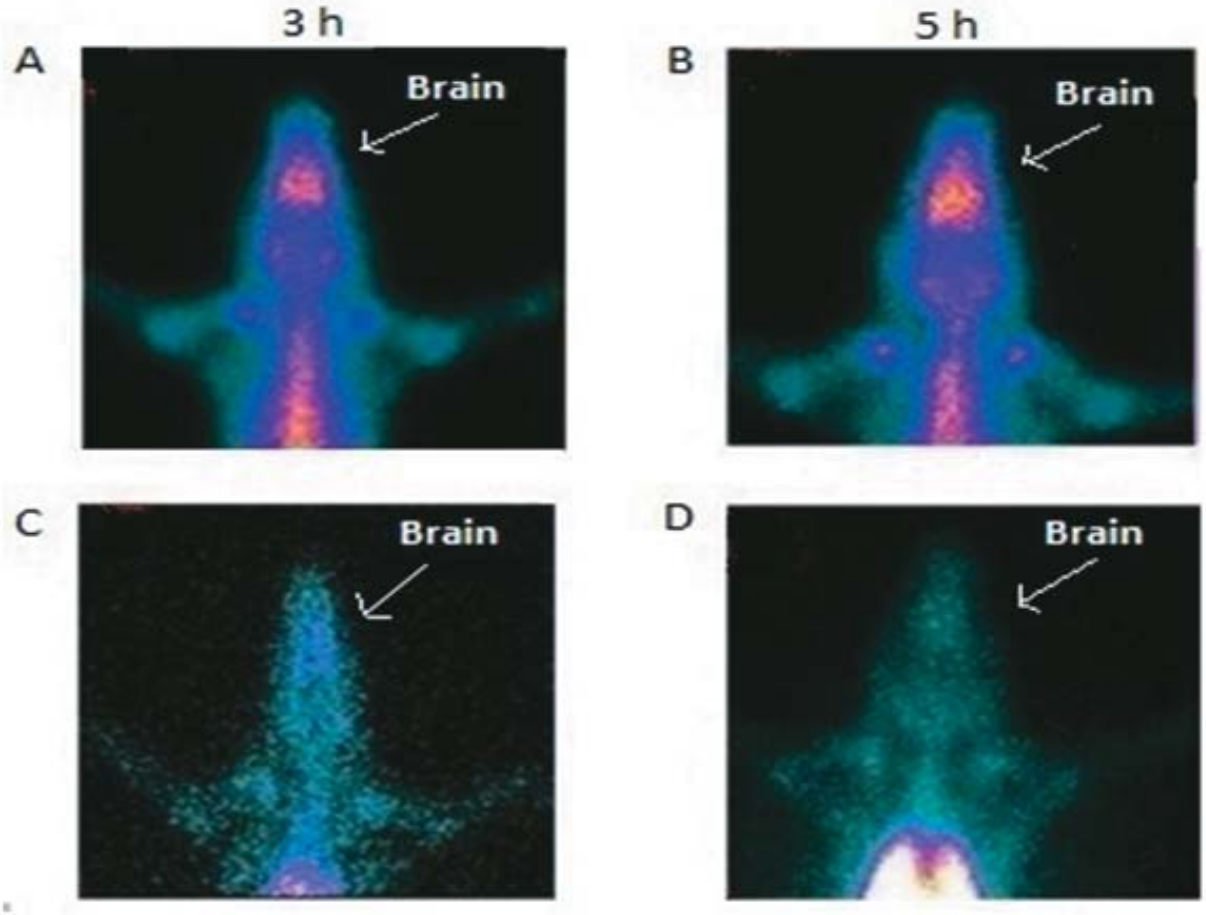

Fig. 2: Gamma scintigraphy images of rat brain at 3h (A & C) and 5h (B & D) post injection time period. Animals received (i.v injection) ^{99m}Tc-nanoformulation (A & B) and ^{99m}Tc-free drug (C & D)

PUBLICATIONS

Ganguly S., Gaonkar R.H., Sinha S., Gupta A., Chattopadhyay D., Chattopadhyay S., Sachdeva S.S., Ganguly S. and Debnath M.C. (2016) Fabrication of surfactant-free quercetin-loaded PLGA nanoparticles: evaluation of hepatoprotective efficacy by nuclear scintigraphy. *J Nanopart Res* **18:**(196), 1-14.

Baishya R., Nayak D.K., Kumar D., Sinha S., Gupta A., Ganguly S. and Debnath M.C. (2016) Ursolic acid loaded plga nanoparticles: in vitro and in vivo evaluation to explore tumor targeting ability on b16f10 melanoma cell lines. *Pharm Res* **33,** 2691-2703

Satapathy B.S., Mukherjee B., Baishya R., Debnath M.C., Dey N.S. and Majhi R. (2016) Lipid nanocarrier-based transport of docetaxel across blood brain barrier. *RSC Adv* **6,** 85261-85274

EXTRAMURAL FUNDING

Evaluation of the therapeutic efficacy of liposomal and nanoparticulated flavonoids in combating oxidative hepatocellular degeneration. July 2013 to March 2017(DAE, BRNS-Mumbai, India)

In vitro and in vivo evaluation of $^{99m}Tc(CO)_3$- labelled RGD conjugated bioreductive pharmacophore and nucleoside analogue for potential use as tumor targeted SPECT radiopharmaceuticals September 2015 August 2018 (SERB, DST-India)

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

Organised a Training Programme on Laboratory Safety: Biosafety, Chemical Safety Radiation Safety and Fire Safety on 30th January, 2017, J.C. Roy Auditorium, CSIR-Indian Institute of Chemical Biology Jadavpur campus.

Cancer Biology & Inflammatory Disorders Division

Dr. Samit Chattopadhyay, Dr. Snehasikta Swarnakar (Head), Dr. Mrinal K. Ghosh, Dr. Malini Sen, Dr. Dipyaman Ganguly, Dr. Amitava Sengupta Dr. Shila Elizabeth Besra and Dr. Krishna Das Saha

Our division is actively engaged in unveiling the mechanisms of several inflammatory diseases and cancers including gastric cancers, lung cancers, glioblastoma and leukemia. The main thrust of our group is centered on several projects by exploiting cutting edge-approches e.g.. transcriptomic, genomic, metabolomic, proteomic, glycomic and bio-informatic. The other important interest encompasses discovery of new therapeutics using natural products and target-based synthetic peptides against different signaling molecule of cancer cells in culture. Our research articles on cancer biology and inflammation biology received huge appreciation by vast scientific community of the world. Followings are the research areas:

Assess the severity of gastric cancer by detection of matrix metalloproteinase (MMP)-7 activity. Protection of endometriosis by restoring the balance between MMP-9 vs. tissue inhibitor of metalloprotease-1. Novel flavonoid from *Azadiracta Indica* leaves as inhibitor of MMP9 activity and as anti ulcer agent.

Implications of small compounds to treat inflammatory bowel diseases (IBD) through balancing between Th17 and Treg. Maintenance of cellular homeostasis through transcriptional regulation by matrix binding protein, namely SMAR1. Understanding the role of Wnt signaling in immune response, infection, inflammation and Wnt-Induced Signaling Proten -3 (WISP3) in sustenance of the musculoskeletal system. Establish Wnt5a signaling as host defence against infections by microbial pathogens. Studies on the redox level of chondrocytes and regulation of mitochondrial functions.

Understanding the role and regulation of innate immune cells, particularly dendritic cells, in sterile contexts of inflammation, including autoimmunities, metabolic syndrome and cancer. Discover a critical pathogenetic event in obesity associated metaflammation and insulin resistance and to identify the role of a tumor cell derived metabolite in intratumoral immunosuppression. Develop novel small molecule antagonists of toll-like receptor 9, in a number of sterile autoreactive clinical contexts.

Work on cell-autonomous and non-cell-autonomous molecular determinants that regulate hematopoietic stem cells (HSC) self-renewal, differentiation and interaction with hematopoietic microenvironment. Identify i) cell-autonomous mechanisms of hematopoietic stem cell transformation, ii) epigenetic regulation of leukemia stem cell heterogeneity, and iii) microenvironment regulation in hematopoiesis. Underpinnings of dysregulated nucleosome remodeling, intra-cellular heterogeneity in human myelodysplasia and acute myeloid leukemia are other interested areas.

Design different types of stable, cost-effective and non-immunogenic nano particles having partially or fully controlled release efficacy during their delivery. Prepare, (a) green synthesized metal nanoparticles (gold nanoparticles conjugated with pure natural compounds and active component rich plant extracts), (b) glucose capped gold nanoparticles (c) magnetite polymeric nanocomposites (magnetite PLGA coated quercetin/curcumin/andrographolide), (d) folic acid tagged mesoporous nano particle conjugated with anticancer agents. Studies on the pharmacodynamics and pharmacokinetics of nanoparticles in cancer and diabetes model. Attempt for drug development from natural and synthetic sources against hepatic disorders and cancers.

Studies on association of EGFR and Wnt/β-catenin signaling during initiation and progression of cancer. Involvement of Wnt signaling in regulation of the EGFR and CK2 pathway and cross-talk between them. Open up new avenues in the combinatorial therapeutic approach for killing cancer cells via (a) Wnt/β-catenin, EGFR, NF-kB and ER pathways (b) 'CK2-PML-FoxO3a' and 'CK2-PP2A-Stat3' signaling routes in prostate cancer and glioma (c) RNA helicase, p68 as important target in cancer therapy. (d) post-translational regulation of oncogenes and tumor suppressors (pRB and p53) by E3 ligase CHIP and deubiquitinase HAUSP.

Dr. Samit Chattopadhyay

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Understanding novel functions of the tumor suppressor protein, SMAR1

Participants

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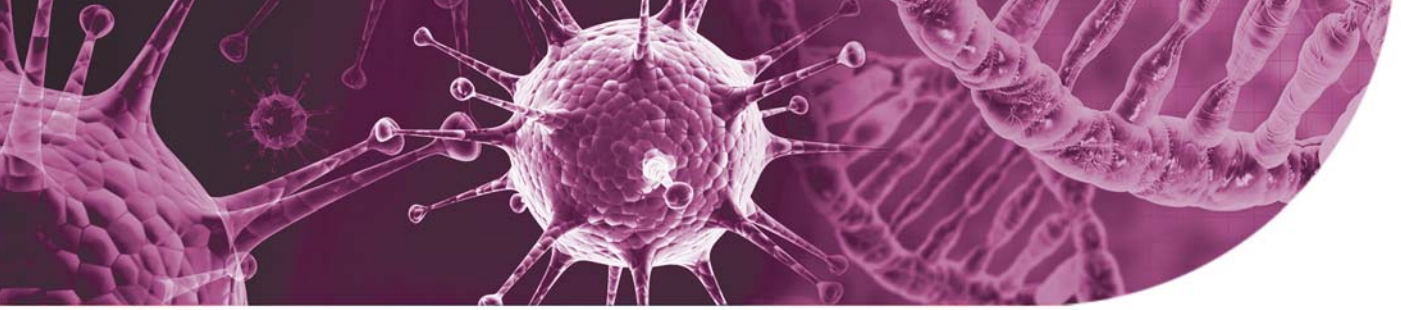
Structural Biology & Bioinformatics Division

Background

The nuclear matrix provides structural framework to the nucleus, tethering several proteins which are important for many processes like transcription, splicing, DNA repair etc. The nuclear chromatin is organized in loops by the nuclear matrix, thus modulating the chromatin architecture. Scaffold Matrix Attachment Binding Protein 1 (SMAR1) is a nuclear matrix-binding protein and belongs to a family of BEN domain proteins. This BEN domain is crucial for the DNA binding and protein binding function of these proteins. Earlier studies from our lab have shown that SMAR1 is a chromatin modifier which recruits HDAC1 to the promoter and brings about modulation of the activity of promoter like that of Cyclin D1. SMAR1 was also reported to regulate apoptosis and survival by regulating the expression of Bax and Puma. Recently, SMAR1's role as a stress response protein was elucidated, wherein SMAR1 was reported to modulate the acetylation status of Ku70 by interacting with HDAC6 (Chaudhary et. al. 2014 *Cell Death and Disease*). Additionally, SMAR1 was reported to negatively regulate alternative splicing by modulating the acetylation status of Sam68 by recruiting HDAC6 (Nakka et. al. 2015 PNAS). Recently we also showed that the switch between effector T cells and regulatory T cells is governed SMAR1. T cell polarization is controlled by SMAR1 as SMAR1 allows the T cells to commit to Th2 lineage and suppresses the Th1 and Th17 lineage commitment. FoxP3, a major factor in Treg cell differentiation, is controlled by SMAR1 and this maintains the fine balance between the Treg and Th17 phenotypes (Mirlekar et.al. 2015 *Mucosal Immunology, Mirlekar et. al. 2017 Frontiers in Immunology*). ChIP-seq analysis predicted a plethora of SMAR1 gene targets, to which SMAR1 can bind in the presence and absence of p53. A significant number of genes, however, favor the binding of SMAR1 irrespective of the p53 status (Mathai et. al. 2016 *Scientific Reports*).

Aims and Objectives

- Determination of the role of SMAR1 in the Wnt signaling pathway
- Metabolic regulation of epigenetic changes in the tumor suppressor gene SMAR1



- Determination of the role of a nuclear matrix binding protein SMAR1 in vertebrate embryogenesis
- Role and regulation of SMAR1 in the process of Ovarian Tumorigenesis
- SMAR1 regulation and its potential role to modulate the clinical outcome of oral & cervical cancer cases

Work Achieved

Role of SMAR1 in Wnt signaling pathway

Wnt/β-catenin signaling is a hallmark for various diseases including cancers. The Wnt ligands bind to Frizzled receptors and disrupts the "destruction complex" consisting of Axin, Adenomatous polyposis Coli, GSK-3β and Caesin kinase Iα. This allows β-catenin to accumulate in the cytoplasm and translocate into the nucleus. Inside the nucleus β-catenin binds to TCF/LEF family of transcription factors and activates the transcription of β-catenin target genes. However, in normal conditions when Wnt ligands are absent, the "destruction complex" mediates the phosphorylation of β-catenin protein. Phosphorylated β-catenin undergoes proteasomal degradation by β-TrCPI and thus the down-stream target genes are prevented from transcription. We found that aberrant Wnt/β-catenin signaling favours oncogene expression and deregulate tumor suppressors. Here, we report that active Wnt signaling using Wnt 3a CM stimulation promotes SMAR1 (Scaffold/Matrix Attachment Region Binding Protein 1) protein degradation. SMAR1 is a well reported tumor suppressor that antagonizes various oncogene expressions like p300, TGFβ and CD44. It also stabilizes the expression of p53 and regulates cell cycle stage at G2/M phase. Two E3 ubiquitin ligase recognition sequences called the D-box elements viz, "RQRL" and "RCHL" present in SMAR1 amino acid sequence are responsible for SMAR1 protein degradation. Mutation of arginine and leucine to alanine in these D-box elements completely abrogated the Wnt 3a stimulated SMAR1 protein degradation. Human colorectal tissue sections (harbouring polyps) expressed more â-catenin than SMAR1 at basal region of the crypt where stemness is highest due to active Wnt signaling. Polyp tissues from mouse colon expressed more β-catenin and diminished SMAR1 levels than the adjacent tissues. Later, we found that CDC20 (Cell-Division Cycle Protein 20) associates with SMAR1 and mediates proteasomal degradation of SMAR1. However, restoration of SMAR1 let to attenuation of Wnt signaling by controlling the expression of β-catenin gene. SMAR1 occupies the β-catenin promoter and recruits HDAC5 which keeps the promoter in a deacetylate state. In absence of SMAR1 the HDAC5 recruitment fails leading to active transcription of β-catenin mRNA. The promoter activity of β-catenin is enhanced by occupancy of H3K9 acetylation in the β-catenin promoter. Therefore, overexpression of HCT116 cells with SMAR1 downregulates β-catenin whereas SMAR1 knockdown results in increased expression of β-catenin. Increased β-catenin level has been found to be involved in enhancing colorectal cancer tumorigenesis. Hence, downregulation of β-catenin by SMAR1 is seen as a therapeutic potential towards colorectal cancer **(Fig. 1).**

Metabolic regulation of epigenetic changes in the tumor suppressor gene SMAR1

Rapidly proliferating cells show significant increase in glycolysis known as the "Warburg effect". Apart from genotoxic stress, a cell also faces metabolic stress. As these rapidly proliferating cells have a much higher glucose requirement when compared to normal healthy cells, it would be really interesting to study the effects of glucose deprivation on these cells. Reports from previous studies have shown that the levels of SMAR1 in malignant cells are constitutively low, probably because SMAR1 being a tumor suppressor, it is essential that a cancerous cell needs to keep it in a suppressed state. We observe that SMAR1 promoter is methylated at eight CpG dinucleotides, in hepato-adenocarcinoma cell line. This probably answers the question as to how the levels of SMAR1 remain in such a basal level, in these cells.

For the first time we have shown that in HepG2 cells SMAR1 levels are kept low by the promoter hypermethylation and this methylation can be erased and re-introduced just by changing the metabolic conditions. We have further shown that the mechanism by which the promoter is methylated and de-methylated. This change is seen when the cell is given a metabolic stress by depriving the cells of glucose. We observe that this not only causes a de-methylation but it also causes the loss of histone methylation marks. We also confirmed the

methylation of the SMAR1 promoter in murine liver cancer samples. Our observation showed that the promoter is methylated in higher grades of cancer and that also reduces the transcript level of SMAR1 in these murine tumor samples. Apart from methylation status of the promoter and different histone modifications we have also investigated the possible role of the STAT3-Dnmt1 axis in this entire mechanism and we have found some significant leads. As a result of the regulation, we have shown, for the first time that SMAR1 controls the acetylation of GAPDH, which is required for the enzymatic function.

Role of a nuclear matrix binding protein SMAR1 in vertebrate embryogenesis

SMAR1 has been shown to have a multifaceted role. It acts as a tumor suppressor by virtue of its interactions with p53, in modulation of cell cycle and in inhibition of migration by modulating the TGFβ pathway, etc. However, the role of SMAR1 in vertebrate development remains unclear. Here, we report the presence of SMAR1 in zebrafish, which shares 66% homology with mouse version of SMAR1. The expression of SMAR1 in zebrafish was validated both at the transcript and protein levels by semi-quantitative PCR and western blotting. Whole mount RNA in-situ hybridization revealed the spatial distribution pattern of SMAR1 mRNA in the developing embryo, showing localization of the probe around the brain ventricles and in the posterior region, which is considered to be hematopoietic part. Cloning of the ORF and protein expression, followed by its purification by affinity chromatography have been achieved. This purified protein was confirmed as SMAR1 from zebrafish using MALDI.

Morpholino antisense oligonucleotide against SMAR1 transcript was used to block the translation of SMAR1 and knockdown in the embryos was achieved. Knock-down of SMAR1 was marked by embryonic malformations - smaller head size, pericardial edema and a linear heart tube phenotype. Taken together, these results indicate that SMAR1 might be regulating embryogenesis, particularly cardiogenesis, in zebrafish. To pinpoint how SMAR1 is involved in any of these developmental pathways, a holistic approach was taken and differential whole transcriptome analysis was performed. This revealed several of the transcripts showing variations in the absence of SMAR1. Genes with different molecular functions involved in various biological pathways, markedly cell cycle regulation, mRNA surveillance and FoxO signaling, were altered. The molecular mechanism underlying such malformations might be interesting to study **(Fig. 2).**

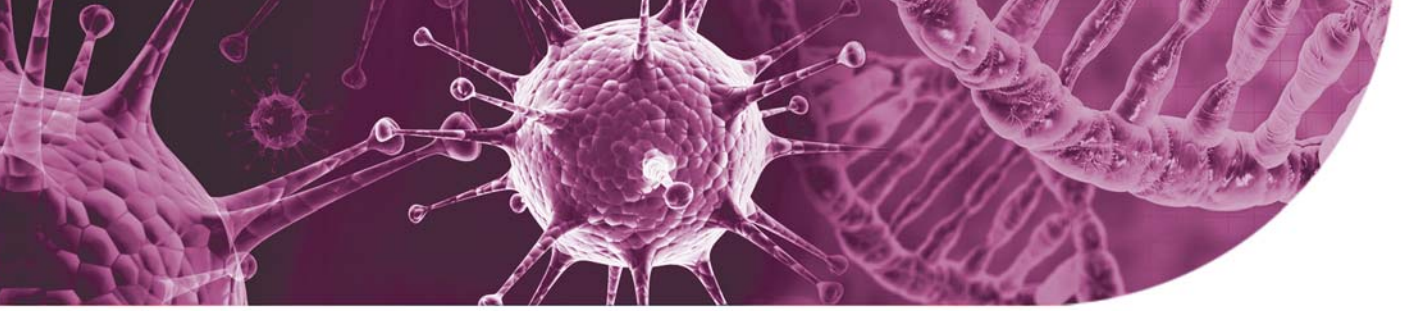
Role and regulation of SMAR1 in the process of ovarian tumorigenesis

As per statistics, ovarian cancer occupies third position after cervical and breast cancer in terms of incidence in women. It is associated with poor five years survival (30 to 40 percent) compared to other solid cancers and has high mortality and recurrence rates. Early diagnosis is difficult and limited therapeutic interventions exist. Hence it is important to understand the molecular mechanisms driving the disease in order to design better therapeutic interventions.

SMAR1 is a matrix associated region binding protein which modulates several oncogenes and tumour suppressors. SMAR1 is a target gene of p53 and has been shown to be dysregulated in other cancers. Interestingly p53 is mutated in about 96% of ovarian cancers. This warrants the need to explore role of SMAR1 in ovarian cancer. As an initial approach we performed a western blot analysis to see the expression level in ovarian cancer cell line OVCAR3 and indeed we found it to be significantly down-regulated. In a quest to identify the factors involved in down regulating SMAR1 we predicted Pim1 kinase as an interacting partner. Pim1 kinase is an oncogenic nuclear serine kinase which promotes survival. Hence to prove the interaction we did an immunoprecipitation assay. Indeed we found it as an interacting partner of SMAR1. Therefore it would be interesting to study further the importance of this interaction in the process of ovarian tumorigenesis.

SMAR1 regulation and its potential role to modulate the clinical outcome of oral & cervical cancer cases

Oral cancer ranks amongst the top three in India. Although it is easily detectable and symptoms occur earlier, patients present at a late stage. The overall disease specific mortality rate is 49%. In India it is of significant public health interest due to its high occurrence and expensive treatment regimen. Usually these cancers are associated with use of tobacco, betel quid, areca nut, smoking and alcohol consumption.



Several oncogenic pathways including EGFR, TGF-b, c-myc etc. have been implicated in the development of oral cancer. Simultaneously, loss of tumour suppressor genes have also been found. For example p53 is either deleted or there is a gain of function mutation in it which confer the cells with increased survival potential. Together multiple mechanisms operate to mediate this process of tumorigenesis.

Scaffold/Matrix Attachment Region Binding protein or SMAR1 a known tumour suppressor gene which has to shown to play essential tumour suppressor roles in different cancers like breast, colon etc. Incidentally it has a direct relation with p53. SMAR1has been shown to stabilize p53 and p53 also regulates SMAR1. Therefore it would be very interesting to investigate the role of SMAR1 in modulating the clinical outcome of oral cancer cases.

Not much data is available on SMAR1 in oral cancer. However some initials studies done in our lab finds that the expression level of SMAR1 is down-regulated in oral cancer cell line. Therefore further exploration is needed to understand the mechanistic details.

Future Research Plans

Regulation of catalytic subunit of telomerase by SMAR1

Role of SMAR1 in tumor cell metabolism via regulation of PKM alternative splicing

To decipher the role of SMAR1 in adipogenesis: Its implication in obesity-related cancer

To gain mechanistic insights into LPS-regulated cancer progression: Fine-tuning of the tumor suppressor SMAR1

Studies on chromatin remodeling protein SMAR1 in CD4+ memory Tcell differentiation

Transcriptome analysis to identify key pathways regulated in ovarian, oral and cervical cancer by SMAR1

Mechanistic studies on Pim1 mediated SMAR1 down-regulation

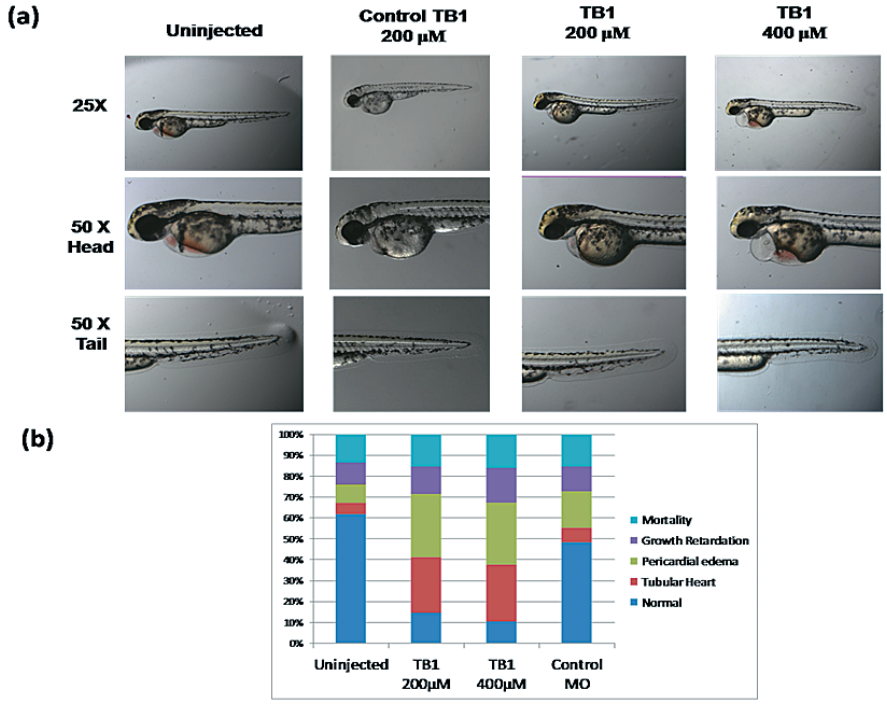


Fig. 1: Model of SMAR1 regulation upon Wnt signaling activation. (a) In the presence of active Wnt 3a ligand binding to Frizzled receptor the levels of CDC20 increases. Increased interaction of CDC20 with SMAR1 mediates more SMAR1 proteasomal degradation. SMAR1 occupancy in the β-catenin promoter decreases leading to increased transcription of β-catenin mRNA. (b) In the absence of Wnt 3a ligand, the endogenous level of CDC20 is not able to increase SMAR1 proteasomal degradation. Thus, increased occupancy of SMAR1 in the β-catenin promoter increases along with HDAC5. This effect leads in the decreased promoter activity of β-catenin leading to its decreased expression.

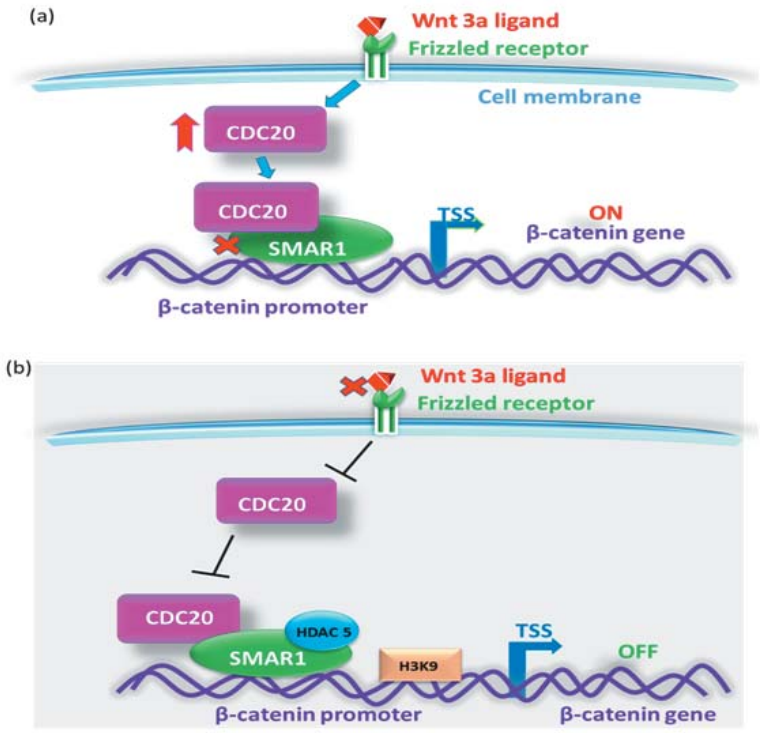


Fig. 2: Phenotypic changes observed in zebrafish embryos upon MO-induced SMAR1 knock-down. (a) Visible phenotypic changes including pericardial edema, tubular heart and smaller cranial size. (b) Quantitation of the phenotypic changes upon SMAR1 knockdown as compared to normal embryos.

PUBLICATIONS

Mathai J., Mittal S.P., Alam A., Ranade P., Mogare D., Patel S., Saxena S., Ghorai S., Kulkarni A.P., Chattopadhyay S. SMAR1 binds to T(C/G) repeat and inhibits tumor progression by regulating miR-371-373 cluster. Sci Rep. 2016 Sep 27;6:33779.

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Ramu V., Aute S., Taye N., Guha R., Walker M.G., Mogare D., Parulekar A., Thomas J.A., Chattopadhyay S. and Das A. (2017) Photo-induced cytotoxicity and anti-metastatic activity of ruthenium(ii)-polypyridyl complexes functionalized with tyrosine or tryptophan. *Dalton Trans* **46,** 6634-6644

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Agarwalla H., Mahajan P.S., Sahu D., Taye N., Ganguly B., Mhaske S.B., Chattopadhyay S. and Das A. (2016) A Switch-On NIR Probe for specific detection of Hg2+ Ion in aqueous medium and in mtochondria. *Inorg Chem* **55,** 12052-12060

A. AH, Ali F., Kushwaha S., Taye N., Chattopadhyay S. and Das A. (2016) A cysteine-specific fluorescent switch for monitoring oxidative stress and quantification of aminoacylase-1 in blood serum. *Anal Chem* **88,** 12161-12168

Pal S., Ramu V., Taye N., Mogare D.G., Yeware A.M., Sarkar D., Reddy D.S., Chattopadhyay S. and Das A. (2016) GSH induced controlled release of levofloxacin form a pur-pose-built prodrug: luminescence response for probing the drug release in e-coli and staphylococcus aureus. Bioconjugate Chemistry. IF 4.51

AWARDS / HONOURS / MEMBERSHIPS

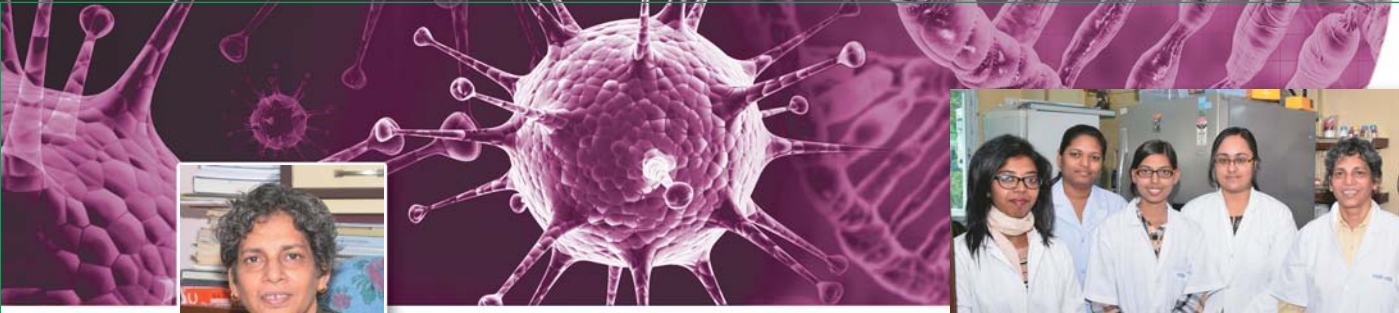
Student

Nakka Kiran Kumar

INSA Medal for Young Scientist

CONFERENCES / WORKSHOPS

India: 1 Abroad: 1



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Importance of matrix metalloproteases in endometriosis and gastric inflammation

Participants

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SRF: Nillu Ghosh, Dharmendra Kumar Yadav, Sugreev Verma, Nilanjana Deb

RA: Dr. Satyabrata Ghosh, Dr. Rajib Majumder Jana, Kasturi Chatterjee

Project Fellow: Preety Choudhary, Dr. Sandeep Dube, Tanusree Das, Avidip Konar, Sayantan

Woman Scientist: Dr. Sibani Sarkar

Sr. Technician: Anirban Manna

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Collaborators within CSIR-IICB:

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Infectious Diseases and Immunology Division

Dr. Nakul C. Maiti
Structural Biology & Bioinformatics Division

Background

We work on different diseases and their pathogenesis including gastric ulcer, gastric cancer, endometriosis and ovarian cancer. Different causative factors and their mechanism of actions are our ongoing interest. We address how cross-infection by different *Helicobacter pylori* strains influences gastric inflammation and immune responses. We screen and identify natural compounds as anti-inflammatory or anti-ulcerative agents and their molecular mechanism of action. My laboratory is interested in understanding the role of matrix metalloproteinases (MMPs), a group of zinc containing, calcium dependent endopeptidases which are involved in degradation of different extracellular matrix proteins in different disease progression including gastric ulceration, endometriosis, and cancer. In addition to promoting cellular migration and invasion of different Tissues, certain MMPs are involved with specific regulation of other cellular responses as well. The epigenetic regulation of MMPs and association with MMP promoter polymorphism in gastric cancer and endometriosis are under progression. Finding a specific inhibitor to abrogate MMP activity to fight against a number of disease pathogenesis is our major goal.

Aims and Objectives

- To understand specific action(s) of MMPs in different patho-physiological responses
- To understand the association of MMP promoter polymorphism with development and progression of gastric cancer and endometriosis
- Screening and identification of natural compounds as novel MMP inhibitors to fight against inflammatory disorder and cancers

Work Achieved

Our research has established the regulation of MMP-2 activity in endothelial cells and on angiogenesis during progression of ovarian endometriosis. Histological and biochemical data showed increased expressions of vascular endothelial growth factor (VEGF), VEGF receptor-2, cycloxygenase (COX)-2, von Willebrand factor along with angiogenesis during endometriosis progression **(Fig. 1).**

Future Research Plans

To develop a diagnostic kit for early detection of endometriosis and gastric cancer using MMP3 and MMP7 respectively as a probe.

H. pylori infection and related immunobiology and role of virulent factor in disease manifestation.

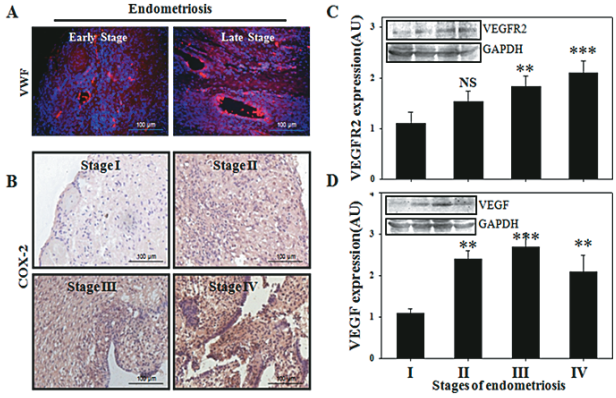


Fig. 1: Involvement of angiogenesis in ovarian endometriosis progression. (A) Immunofluorescence for Von Willebrand factor (red flourescence) in early and late stages (n = 3 samples/stage) of ovarian endometriosis. Nucleus was stained with DAPI (blue flourescence). (B) Immunohistochemistry for cycloxygenase-2 in different stages (n = 3 samples/stage) of endometriosis. (C-D) Quantification of VEGF receptor-2 (n = 14 samples/stage) and VEGF expressions (n = 12 samples/stage) in ectopic samples of endometriosis.

Women with endometriosis showed decreased MMP-2 activity in eutopic endometrium as compared to women without endometriosis. However, ectopic ovarian endometrioma showed significantly elevated MMP-2 activity with disease severity. In addition, increased MT1MMP and decreased tissue inhibitors of metalloproteinases (TIMP)-2 expressions were found in the late stages of endometriosis indicating more MMP-2 activation with disease progression. *In vitro* study using human endothelial cells showed that prostaglandin E2 (PGE2) significantly increased MMP-2 activity as well as tube formation. Inhibition of COX-2 and/or phosphorylated AKT suppressed MMP-2 activity and endothelial tube formation suggesting involvement of PGE2 in regulation of MMP-2 activity during angiogenesis **(Fig. 2).**

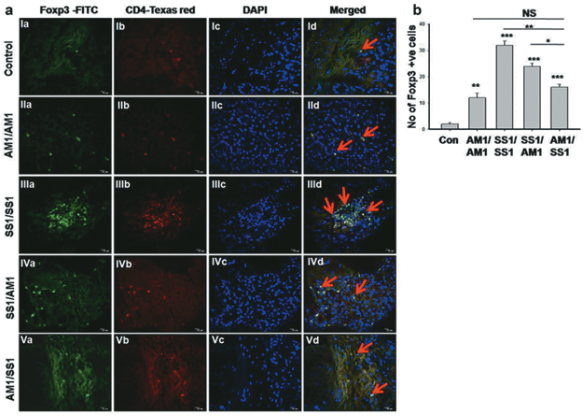


Fig. 2: Inhibition of prostaglandinE2 attenuates tube formation along with MMP-2 activity in endothelial cells. (A,B) HUVEC cells were inoculated on matrigel in the presence of PGE2 (1 ìM) with or without AKT1/2 kinase inhibitor (5 ìM), or only COX-2 inhibitor (5 ìM) and tube formation was monitored. (C,D) Gelatin zymography was performed to assess MMP-2 activity from cell supernatant.

Moreover, specific inhibition of MMP-2 by chemical inhibitor significantly reduced cellular migration, invasion and tube formation. *In ovo* assay showed decreased angiogenic branching upon MMP-2 inhibition. Furthermore, a significant reduction of lesion numbers was observed upon inhibition of MMP-2 and COX-2 in mouse model of endometriosis. In conclusion, our study establishes the involvement of MMP-2 activity via COX-2-PGE2-pAKT axis in promoting angiogenesis during endometriosis progression. Currently, the mechanism for MMP-7 in promoting invasiveness in ovarian endometriosis was also being studied, where epithelial to mesenchymal transition-inducing roles of MMP-7 were observed.

Gastric inflammation is mainly caused by *Helicobacter pylori* infection and the outcome of the infection lies on virulance in *H. pylori* strains and host factors. *H. pylori,* colonize in stomach of ~50% of the world population.cag pathogenicity Island of *H. pylori* is one of the important virulent factors that attributed to gastric inflammation. Coinfection with *H. pyloristrain* with different genetic makeup alters the degree of pathogenicity and susceptibility towards antibiotics. The present report investigates host immunomodulatory effects of *H. pylori* infection by both cag $^{+}$ strain (SS1) and cag $^{-}$ strain (AM1). C57BL/6 mice were infected with AM1 or SS1 strain as well as AM1 followed by SS1 (AM1/SS1) and vice versa. Our data suggested that prior *H. pylori* cag $^{-}$ strain infection attenuated the severity of gastric pathology induced by subsequent cag $^{+}$ strain in C57BL/6 mice. Prior AM1 infection induced Th1 cytokine IFN-γ, which reduced the Th17 response induced by subsequent SS1 infection. The reduced gastritis in AM1/SS1-infected mice might also be due to enrichment of AM1- primed Treg cells in the gastric compartment which inhibit Th1 and Th17 responses to subsequent SS1 infection **(Fig. 3).**

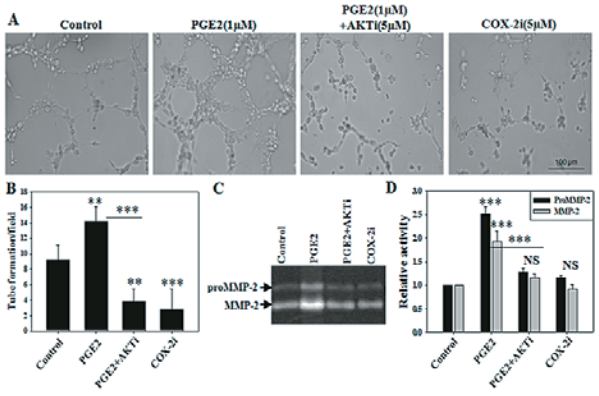
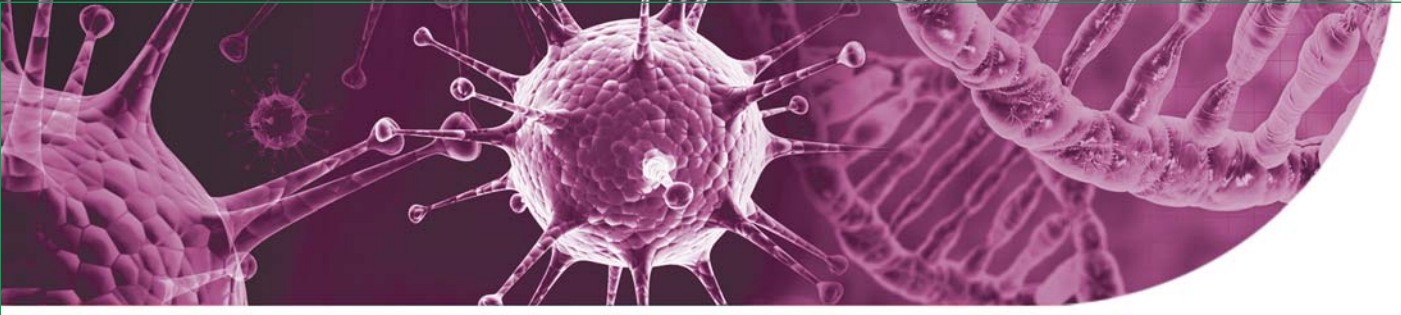


Fig. 3: Population of Foxp3+ Treg cells in *H. pylori* infected mouse gastric tissues. C57BL/6 mice were orogastrically inoculated twice in a period of three days with either AM1 (cag $^{+}$) or SS1 (cag $^{-}$) strain (AM1/AM1 and SS1/SS1) and the rest 2 groups were given criss-cross infection. Criss–cross means infection by cag $^{+}$ strain followed by cag $^{-}$ and vice versa (AM1/SS1 and SS1/AM1). *H. pylori* infected and uninfected gastric tissues were stained for regulatory T cell marker Foxp3 and CD4. Foxp3 were stained with fluorescein isothiocyanate (FITC) (green) (Ia–Va), CD4 were stained with Texas red (red) (Ib–Vb), nuclei were stained with DAPI (Ic–Vc), while (Id–Vd) represent their merge pictures.



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Yadav D.K., Bharitkar Y.P., Hazra A., Pal U., Verma S., Jana S., Singh U.P., Maiti N.C., Mondal N.B. and Swarnakar S. (2017) Tamarixetin 3-O-beta-d-glucopyranoside from azadirachta indica leaves: gastroprotective role through inhibition of matrix metalloproteinase-9 activity in mice. *J Nat Prod* **80,** 1347-1353

Ghosh N., Ghosh P., Kesh K., Mukhopadhyay A.K. and Swarnakar S. (2017) Attenuation of Helicobacter pylori-induced gastric inflammation by prior cag-strain (AM1) infection in C57BL/6 mice. *Gut Pathog* **9,** 14

Sarkar S., Mukherjee A., Das N. and Swarnakar S. (2017) Protective roles of nanomelatonin in cerebral ischemia-reperfusion of aged brain: Matrixmetalloproteinases as regulators. *Exp Gerontol* **92,** 13-22

Jana S., Chatterjee K., Ray A.K., DasMahapatra P. and Swarnakar S. (2016) Regulation of matrix Metalloproteinase-2 Activity by COX-2-PGE2-pAKT Axis promotes angiogenesis in endometriosis. *PLoS One* **11,** e0163540

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Book Chapters / Invited Reviews

Snehasikta Swarnakar and Sayantan Jana (2017) Matrix Metalloproteinases. Encyclopedia of Signaling Molecules (2nd Edition), *Springer publishing group,* USA, (Ed. Dr. S. Choi), pp.1-9.

PATENTS FILED / SEALED

Name Surname: PARASURAMAN JAISANKAR * AND SNEHSIKTA SWARNAKAR, .*

Patent Title: 3-INDOLYL FURANOID AS INHIBITOR OF MATRIX METALLOPROTEINASE 9 FOR PREVENTION OF GASTRIC ULCER AND OTHER INFLAMMATORY DISEASES

Country(ies): INDIA

Patent No.: Appl. No. 201711005308

Date filed / granted: 15th Feb 2017

Co-inventors and their Institutes Chatterjee, S., Verma, S., Raychaudhuri, S., CSIR-IICB, Kolkata

Patent filed by DBT / CSIR-IICB / another organization: CSIR-IICB, Kolkata

EXTRAMURAL FUNDING

Mechanistic evaluation of anti-cancer property against in vitro and in vivo cancer models with the active constituents of the bark of Diospyros melanoxylon. April, 2016 March, 2019 (ICMR, India)

Role of Matrix Metalloproteinases and heat shock proteins in stress induced gastric cell damage: Effect of antioxidants thereon. May, 2015 May, 2018 (LSRB-DRDO, India).

CONFERENCES / WORKSHOPS

Number of abstracts

India: 4 International: 11

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

3rd International Meet on Advanced Studies in Cell Signaling Network (CESIN), CSIR-IICB, 18-20 December 2016, Kolkata, India

INVITED TALKS

Chemistry in the perspective of human health; Budge Budge College, 11 May, 2016, Kolkata

Novel Therapeutic Targets for Inflammatory Disorders; Two days National Workshop on technology up-gradation & pharmaceutical promotion; Invited talk; NIPER, 29-30 July, 2016. Kolkata

Matrix metalloproteinase-2 in disease dynamics: Role of Angiogenesis; 3rd International Meet on Advanced Studies in Cell Signaling Network (CESIN); Plenary talk; CSIR-IICB, 18-20 December, 2016. , Kolkata

Underlying mechanism of endometriosis in the light of matrix metalloproteinases: antioxidants on rescue; SFRR-India-17; BARC, 09-12 January, 2017. Mumbai

Walking through a tricky trail of metalloproteinases: Landscape in disease dynamics; CSIR-IICB, 19 January, 2017, Kolkata

Matrix metalloproteinase-7 (MMP-7) and MMP-9 transcriptional polymorphism are well liked with gastric cancer risk in eastern Indians, 20th ADNAT Convention International Symposium;KIIT University, ADNAT; 16-18 February, 2017, Bhubaneswar

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Mechanistic elucidation of signaling crosstalks in cancer and therapeutic intervention through targeted drug delivery systems

Participants

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JRF: Gouranga Saha, Satadeepa Kal, Dipankar Chakraborty, Bhaskar Basu, Shaheda Tabassum, Sayak Chakravarti, Rajni Shaw, Shrabastee Chakraborty, Dr. Paramita Bhattacharya, DST-WOS

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Structural Biology Division

Background

There are numerous levels of protection that cancer cells must overcome in order to form a malignant tumor. To break through these line of defenses, cancer cells must acquire certain biological capabilities, including sustaining proliferative signaling, avoiding apoptosis and reprogramming cellular metabolism. Many molecular players come into action in order to initiate and progress oncogenesis. Tumor suppressors such as Rb, p53 and PTEN which keep scrupulous cellular growth in check are lost functionally; whereas proteins accelerating growth, such as STAT3, β-catenin, etc are up-regulated.

PTEN mutation/deletion is a frequent feature across a plethora of human cancers, the hot-spot being its C-terminus (PTEN-CT) regulatory domain resulting in a much diminished protein expression. The intrinsic regulatory domain of PTEN is required for its stabilization and inhibition of tumor progression. Therefore analyzing this aspect may provide some therapeutic strategy to curb tumorigenesis.

DEAD box RNA helicase p68 acts as a transcriptional coactivator of several oncogenic transcription factors apart from being a vital player of RNA metabolism. Signal transducer and activator of transcription 3 (Stat3) is a major oncogenic contributor of diverse cancers. Deciphering the mechanistic insights of coactivation of Stat3 transcriptional activity may aid in improved therapeutic strategies.

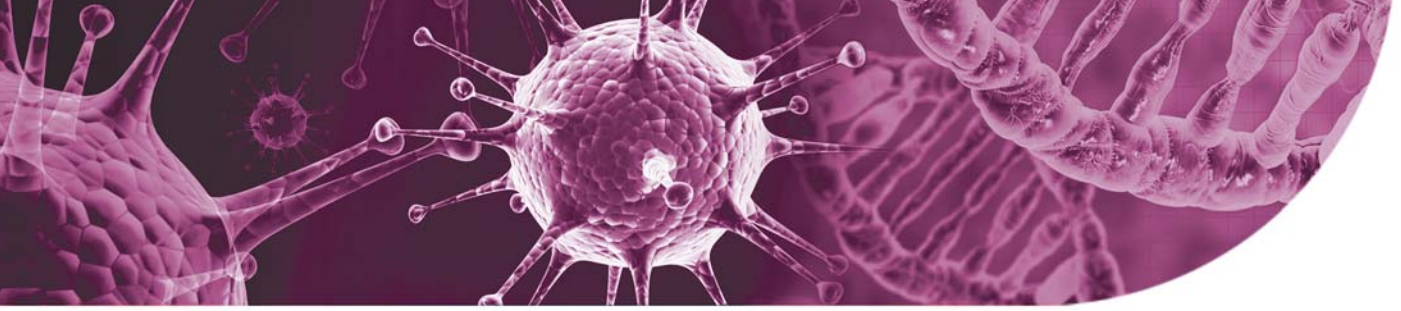
Aims and Objectives

- To investigate the involvement of PTEN-CT on the stability of PTEN and its role in curbing tumorigenesis
- To develop novel exosome mediated delivery system for therapeutic intervention
- To gain mechanistic insights into Stat3 gene regulation and its interaction with p68
- To understand the involvement of p68 as an oncogenic factor

Work Achieved

Exosome-mediated delivery of the intrinsic C-terminus domain of PTEN protects it from proteasomal degradation and ablates tumorigenesis: (SF Ahmed, N Das, M Sarkar and MK Ghosh):

In this study, the presence of C-terminus mutations was confirmed through sequencing of different human tumor samples. The kinase CKII mediated phosphorylation of PTEN at Ser380, Thr382 and Thr383 sites makes it a loopy structure competing with the E3 ligases for binding to its lipid anchoring C2 domain. We designed a novel exosome-mediated delivery of the intrinsic PTEN domain, PTEN-CT into different cancer cells and observed reduced proliferation, migration, and colony forming ability. The delivery of exosome containing PTEN-CT peptide to breast tumor mice model was found to result in significant regression in tumor size with the tumor sections showing increased apoptosis. We also reported for the first time an active PTEN when its C2 domain is bound by PTEN-CT peptide for its stablilization, probably rendering its anti-tumorigenic activities through the protein phosphatase activity **(Fig. 1 & 3).**



The DEAD box protein p68: a novel coactivator of Stat3 in mediating oncogenesis (M Sarkar, V Khare and MK Ghosh):

Here we report for the first time a novel mechanism of alliance between p68 and Stat3 in stimulating transcriptional activity of Stat3. We observed that the expression of p68 and Stat3 bears strong positive correlation and significant colocalization in normal and colon carcinoma patient samples. We demonstrated that p68 directly interacts with Stat3 and positively modulated both mRNA and protein expression levels of Stat3 target genes in multiple colon cancer cell lines. Also, p68 occupied the promoters of multiple Stat3 target genes in enhancing Stat3-dependent transcription. Enhanced expression levels of Stat3 target genes observed in primary tumors and metastatic lung nodules, generated in mice colorectal allograft model using syngeneic cells stably expressing p68, further reinforced our *in vitro* findings. Hence, this study unravelled novel mode of p68-mediated oncogenesis through coactivation of Stat3 and enhancing Stat3 signaling **(Fig. 2 & 3).**

Future Research Plans

Focusing to restore tumor suppressors Rb and PTEN in cancer cells for inhibition of oncogenesis.

Investigating the plethora of genes that might be regulated by p68 and helping in the integration of signals from multiple oncogenic pathways.

Developing peptide/iRNA based therapeutic approaches and further investigation of targeted drug delivery systems using nanovehicles for curbing tumorigenesis.

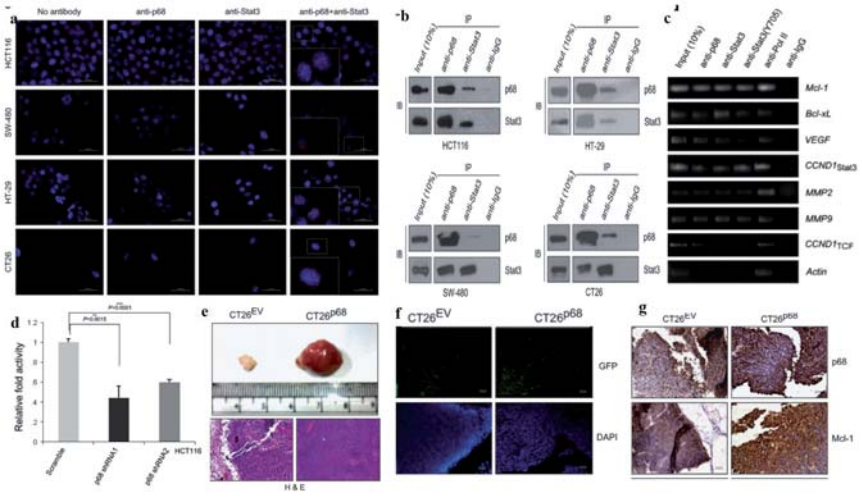


Fig. 2: p68 physically interacts with Stat3 and potentiates expression of Stat3 target genes in colon cancer cells and in primary tumors of mice colorectal allografts.

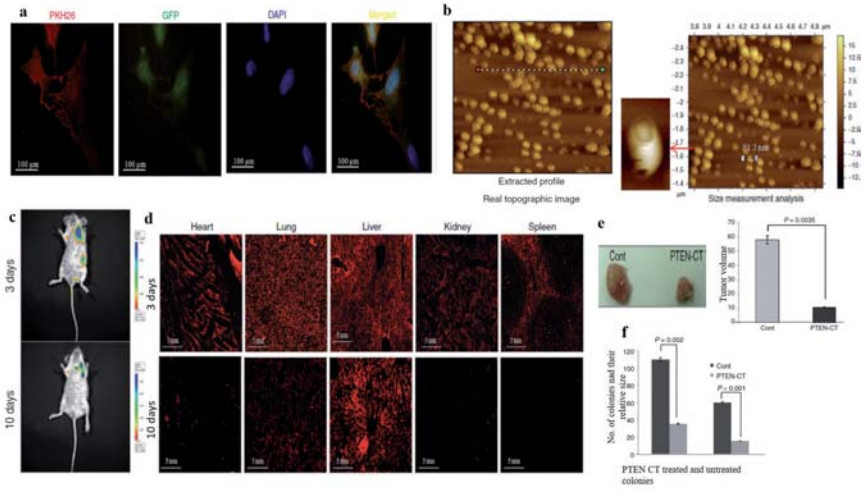


Fig. 1: Exosome mediated delivery of PTEN-CT ablates tumorigenesis in vivo and inhibits cancer cell proliferation

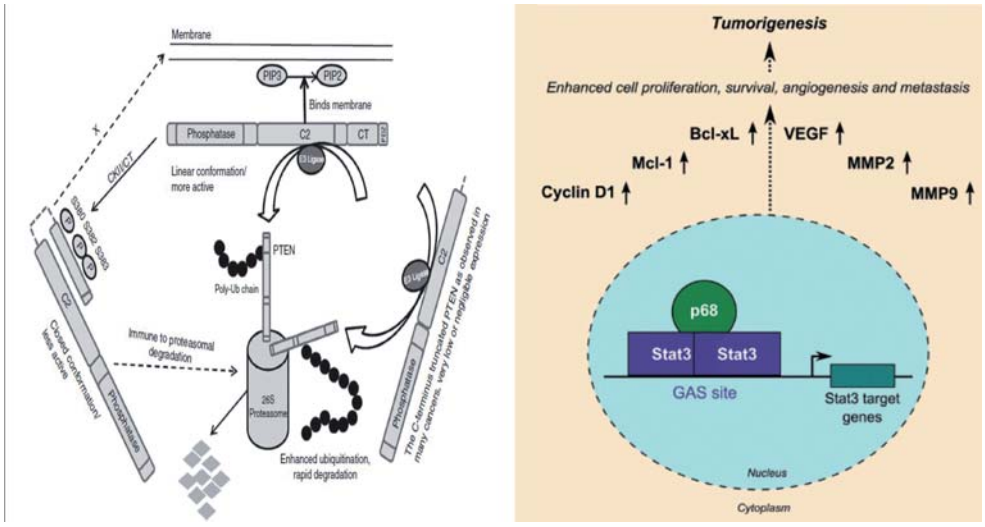


Fig. 3: Models: Schematic representation of (i) Post-translational regulation of PTEN and (ii) p68-mediated upregulation of Stat3 target gene expression involved in oncogenesis.

PUBLICATIONS

Sarkar M., Khare V. and Ghosh M.K. (2017) The DEAD box protein p68: a novel coactivator of Stat3 in mediating oncogenesis. *Oncogene* **36,** 3080-3093

Ghosh A., Bhowmik A., Bhandary S., Putatunda S., Laskar A., Biswas A., Dolui S., Banerjee B., Khan R., Das N., Chakraborty A., Ghosh M.K. and Sen P.C. (2016) Formulation and antitumorigenic activities of nanoencapsulated nifetepimine: A promising approach in treating triple negative breast carcinoma. *Nanomedicine* **12,** 1973-1985.

Das N., Datta N., Chatterjee U. and Ghosh M.K. (2016) Estrogen receptor alpha transcriptionally activates casein kinase 2 alpha: A pivotal regulator of promyelocytic leukaemia protein (PML) and AKT in oncogenesis. *Cell Signal* **28,** 675-687-1734.

Ahmed S.F., Das N., Sarkar M., Chatterjee U., Chatterjee S. and Ghosh M.K. (2015) Exosome-mediated delivery of the intrinsic C-terminus domain of PTEN protects it from proteasomal degradation and ablates tumorigenesis. *Mol Ther* **23,** 255-269

Book Chapters / Invited Reviews

Paul I., Basu M. and Ghosh M.K.(2016). CHIP (Carboxy Terminus of HSC70 Interacting Protein). *Encyclopedia of Signaling Molecules.*

Bhowmik A., Basu M., Ghosh M.K.(2017). Design, synthesis and use of peptoids in the diagnosis and treatment of cancer. *Frontiers in Bioscience, Elit* **9,** 102-09.

Paul I, Basu M. and Ghosh M.K.(2016). Chaperones and Glioma Immunotherapy. *J. Cancer Sci Ther* **8:** 069-070

Sarkar M. and Ghosh M.K. (2016). DEAD box RNA helicases: crucial regulators of gene expression and oncogenesis. *Frontiers in Bioscience, Landmark* **21,** 225-250.

CONFERENCES / WORKSHOPS

Number of abstracts

India: 6

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

3rd International Meeting on Advanced Studies in Cell Signaling Network (CeSiN 2016)18-20 December 2016, CSIR-Indian Institute of Chemical Biology, Jadavpur ,Kolkata

INVITED TALKS

Rα Transcriptionally Activates CK2α: A Pivotal Regulator of Promyelocytic Leukaemia Protein (PML) and AKT-FOXO3a axis in Oncogenesis; International Society for Translational Research (ISTR); Bose Institute, 16-18 April, 2016, Kolkata, India.

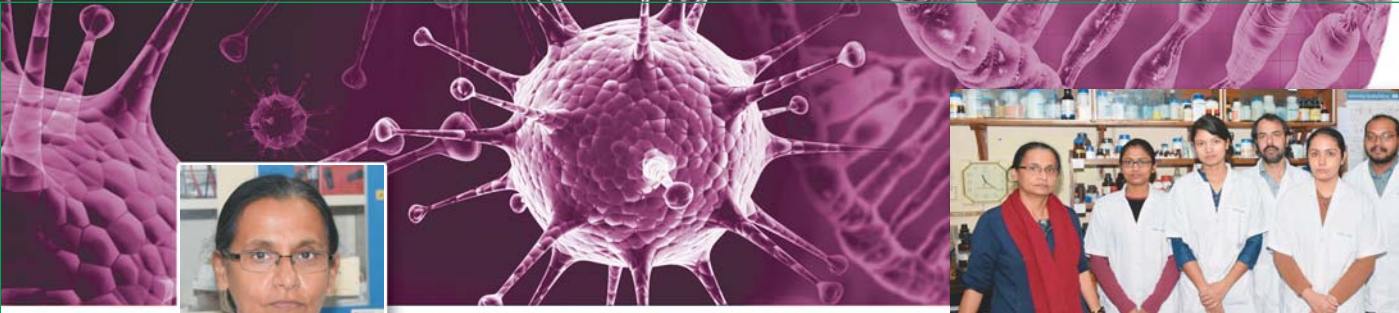
Crosstalk between EGFR and Wnt/β-catenin signalings leads to deregulated gene expression in cancer; KIIT, 14-16 October, 2016, Bhubaneswar, India.

Cellular signaling networks are highly complex and solving this puzzle would help to target the right molecule for cancer therapy; Transcription Assembly-2016, Bose Institute, 8-9 November, 2016, Kolkata, India.

Signalling aberrations lead to Transcriptional and Post-Translational Deregulations in Cancer: Identify and treat the crucial drug targets; 104th Indian Science Congress-2016, S V University, Tirupati, 3-7 January, 2017, Kerala, India.

Involvement of RNA Helicase p68 in mediating oncogenesis; 36th IACR, Amala Cancer Research Centre, Thrissur, 9-11 February 2017, Kerala, India.

Nanotechnology Application in Glioma Therapy: Targeted Drug Delivery through Blood Brain Barrier (BBB); Nanotechnology: From Materials to Medicines and Their Social Impact, BITM, 25 March, 2017, Kolkata, India.



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Wnt5a signaling promotes host defense against Leishmania donovani infection

Participants

JRF: Tresa Rani Saraf, Deepesh Kumar Padhan, Shreyasi Maiti

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RA: Suman Kundu, Archya Sengupta

Collaborators

Collaborators outside CSIR-IICB

Dr. Sushil K. Mahata
University of California, San Diego, USA

Dr. Syamal Roy
NIPER, Kolkata

Background

Leishmania donovani infects macrophages, disrupting immune homeostasis, but the underlying mechanism that sustains infection remains unresolved. In view of the potential of Wnt5a signaling to maintain immune homeostasis, we evaluated the interrelationship of Wnt5a signaling and *Leishmania donovani* infection. Upon infection of macrophages separately with antimony drug sensitive and resistant *L.donovani* we noted disruption in the steady state level of Wnt5a. Moreover, inhibition of Wnt5a signaling by siRNA transfection *in vitro* or by use of Inhibitor of Wnt Production *in vivo,* led to an increase in cellular parasite load. Treatment of macrophages with recombinant Wnt5a on the other hand, caused decrease in the cellular load of both antimony sensitive and resistant parasites, thus confirming that Wnt5a signaling antagonizes *L.donovani* infection. Using inhibitors of the Wnt5a signaling intermediates Rac1 and Rho kinase we demonstrated that Wnt5a mediated inhibition of parasite infection is Rac1/Rho dependent. Phalloidin staining of Wnt5a vs. PBS treated macrophages and live microscopy of *L.donovani* infected macrophages pretreated with Wnt5a vs. PBS furthermore suggested that Wnt5a-Rac1/Rho mediated decrease in parasite load may be promoted by alterations in F- actin assembly and endosomal/lysosomal fusions with parasite containing vacuoles (parasitophorous vacuoles: PV). Increase in PV – endosomal / lysosomal fusion accompanied with augmented PV degradation in Wnt5a vs. PBS pretreated macrophages was furthermore, apparent from Transmission Electron Microscopy of infected cells. Our results suggest that while *L.donovani* evades host immune response at least partly through inhibition of Wnt5a signaling, revamping Wnt5a signaling can inhibit *L.donovani* infection, irrespective of drug sensitivity or resistance.

Aims and Objectives

- Deciphering the interrelation between macrophage Wnt5a signaling and *Leishmania donovani* infection.
- Analyzing the effect of Wnt5a signaling on the sustenance of *L.donovani* containing vacuoles (parasitophorous vacuoles) in macrophages.

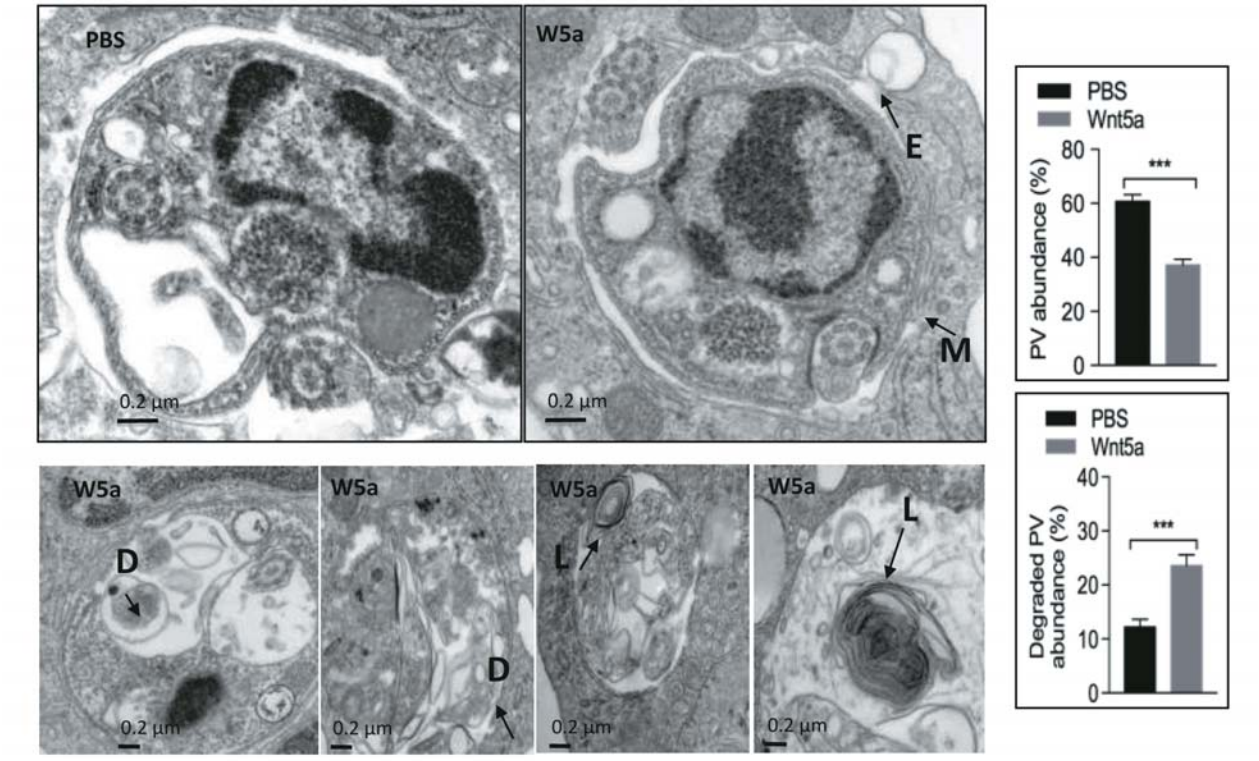


Fig: Electron microscopy depicting parasitophorous vacuole degradation through formation of autophagosome like structure upon application of recombinant Wnt5a to *L.donovani* infected macrophages. PBS is used as vehicle control.

Work Achieved

We have found that (i) *L.donovani* infection suppresses Wnt5a production in macrophages and (ii) activation of Wnt5a-Rac1 mediated modulation of actin assembly leads to degradation of *L.donovani* containing parasitophorous vacuoles.

Future Research Plan

To find out if upregulation of Wnt5a signaling cures *L.donovani* infection in animal model.

PUBLICATION

Chakraborty A., Kurati S.P., Mahata S.K., Sundar S., Roy S. and Sen M. (2017) Wnt5a signaling promotes host defense against leishmania donovani infection. *J Immunol* **199,** 992-1002

EXTRAMURAL FUNDING

Role of Wnt5a in the Initiation and Progression of Sepsis. DBT Govt of India.

Mechanism of metabolic regulation by Wnt-induced secreted protein 3 (WISP3). DST Govt of India

CONFERENCES / WORKSHOPS

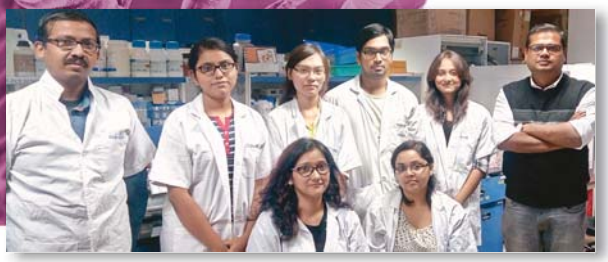
Nunber of abstracts

India : 1

International Conference on Molecular Signaling, Chennai, January 2017.

INVITED TALKS

Role ofWnt5a signaling in *L.donovani* infection. International Conference on Molecular Signaling, January 2017, Chennai, India .



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Dendritic cell biology at the crossroads of autoimmunity, cancer and protective immunity

Participants

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SRF: Amrit Raj Ghosh, Roopkatha Bhattacharya, Oindrila Rahaman, Dr. Pritam Duttagupta

RA: Dr. Shamik Bhattacharya

Collaborator(s)

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Background

The basic premise for immune algorithm is distinguishing self from nonself. This is achieved by different modules of host immune system. The 'innate' immune system recognizes the nonself based on predominantly nonself-associated molecular patterns (PAMPs), while the 'adaptive' immune axis adapts to the nonself molecular determinants. These two work together toward an effective immune response. An effective immune response to an invading pathogen (nonself) leads to protective immunity and a defective response leads to overt infection. On the other hand, an unintended response to the self-entities leads to autoimmune disorders, while a misjudged tolerance to the altered self contributes to tumorigenesis. Our research broadly concentrates on role of innate immune axis in the crossroads of infection, autoimmunity and cancer. Dendritic cells (DCs) are the innate cells with most of the decision-making responsibilities for an ensuing immune response or tolerance. We try to decipher the governing principles of self-nonself discrimination by the germline-encoded invariant pattern recognition receptors (PRRs) expressed by DCs and how they work in a given clinical context.

Aims and Objectives

- Innate immune regulation and molecular mechanisms of dendritic cell function
- Role of innate immune deregulation in autoreactive inflammation
- Deciphering the role and modulation of dendritic cells in tumor microenvironment

Work Achieved

1. First evidence for involvement of plasmacytoid dendritic cells and type I interferons in obesity associated metabolic syndrome in humans. In this study it was first discovered that pDCs are recruited to obese adipose tissue in response to an adipocyte-derived chemokine chemerin. We also found that these pDCs are activated in situ through TLR9 and resulting induction of type I IFNs drive proinflammatory polarization of macrophages in situ. Thus type I IFN induction in adipose tissue was found to be a critical event in obesity associated inflammatory process.

   Ghosh AR et al, Diabetes, 2016 (Citations: 3; Featured widely in National News Media like Indian Express, The Telegraph, Hindusthan Times, NDTV)

2. Development of novel small molecule antagonists for toll-like receptor 9, a promising therapeutic target in systemic autoimmune diseases as they inhibit activation of plasmacytoid dendritic cell activation and type I IFN induction. Pharmacokinetic, toxicity and ADME studies are ongoing and preliminary results identified promising lead molecules.

   Roy S et al, European Journal of Medicinal Chemistry, 2017.

   Patent Appli CSIR Ref No. 0034NF2017, 2017.

   Patent Application No. 201611009670, 2015.

3. First proposition of a syndromic description of clinical entities like systemic autoimmunities and metabolic disorders due to a singular pathogenetic continuum.

   Plenary lecture at 14th International Dendritic Cell Symposium, 2016, Shanghai, China.

Future Research Plans

We plan to further investigate the role of plasmacytoid dendritic cell in contexts of sterile inflammation, perform preclinical validation of the novel TLR9 antagonists in diabetes and systemic lupus. A program on molecular characterization of innate immune events in terms of mechanotransduction and endocannabinoids signaling are also ongoing.

PUBLICATIONS

Roy S., Mukherjee A., Paul B., Rahaman O., Maithri G., Ramya B., Pal S., Ganguly D. and Talukdar A. (2017) Design and development of benzoxazole derivatives with toll-like receptor 9 antagonism. *Eur J Med Chem* **134,** 334-347

Ghosh A.R., Bhattacharya R., Bhattacharya S., Nargis T., Rahaman O., Duttagupta P., Raychaudhuri D., Liu C.S., Roy S., Ghosh P., Khanna S., Chaudhuri T., Tantia O., Haak S., Bandyopadhyay S., Mukhopadhyay S., Chakrabarti P. and Ganguly D. (2016) Adipose recruitment and activation of plasmacytoid dendritic cells fuel metaflammation. *Diabetes* **65,** 3440-3452

Book Chapters / Invited Reviews

Mukhopadhyay S., Dutta D. and Ganguly D. Psoriasis and Diabetes: An association likely missed. Book chapter in 'Psoriasis and Psoriatic Arthritis: Pathophysiology and Therapeutic Interventions' 1st edition 2017, Taylor & Francis, in press.

Mukhopadhyay S., Dutta D. and Ganguly D. (2017) Lipid induced insulin resistance: Molecular Mechanisms and Clinical Implications. Book chapter in 'Nutritional and Therapeutic Interventions for Diabetes and Metabolic Syndrome' 2nd edition, Elsevier, in press.

EXTRAMURAL FUNDING

Ramanujan Fellowship 2013-2018, SERB

Probing endosomal toll-like receptor 9 biology using novel small molecule antagonists, 2015-2018, SERB

Role of type I interferons in cerebral malaria, 2016-2019, DBT

Exploring therapeutic efficacy of novel toll-like receptor 9 antagonists in type 2 diabetes, 2017-2019 SERB

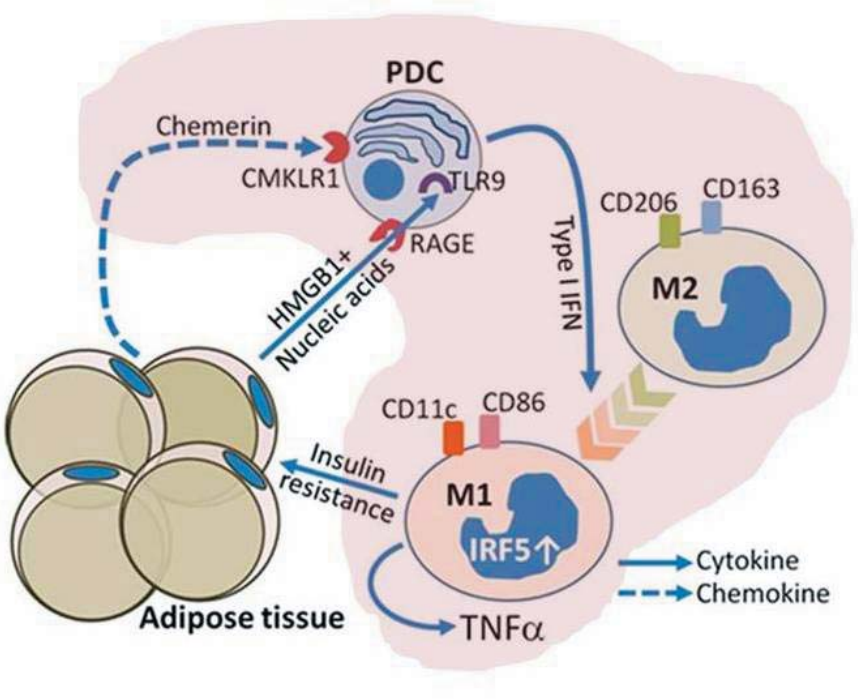
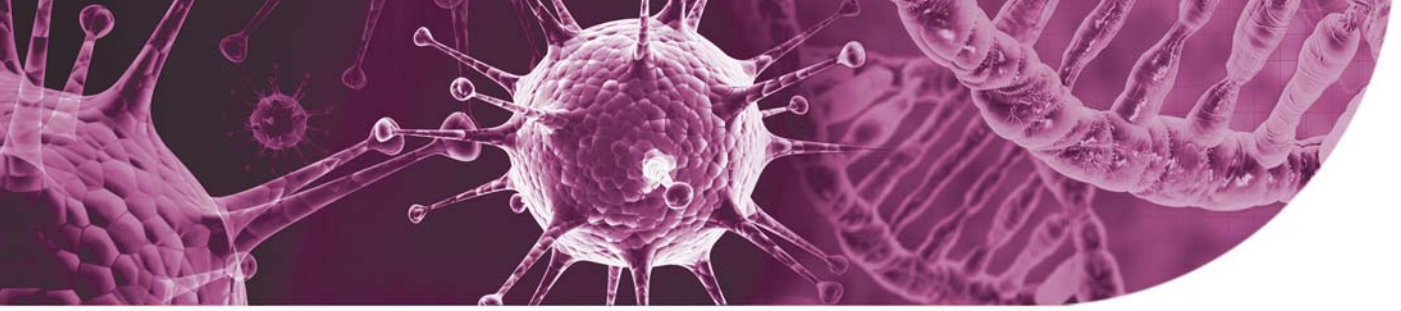


Fig. 1: Pathogenetic model for role of plasmacytoid dendritic cell derived type I interferons in obesity associated metaflammation and insulin resistance (Ghosh AR et al, Diebates, 2016)



No.	Title	Funded by	PI/ Co-PI	Amount (Lakh INR)	Brief description
1	Ramanujan Fellowship	SERB	PI	42.0 (5 yrs, 2013-2018)	Start-up grant to initiate laboratory, used for the project where we discovered a critical role of plasmacytoid dendritic cells and type I IFNs in obesity associated insulin resistance (Ghosh et al, *Diabetes,* 2016)
2	Probing endosomal toll-like receptor 9 biology using novel small molecular antagonists	SERB	Co-PI	32.0 (3 yrs, 2015-2018)	Gaining structural insight into TLR9 antagonism using small molecules and development of novel small molecule antagonists of toll-like receptor 9 (Roy et al, *Eur J Med Chem,* 2017; 2 Patents)
3	Rolenof type I interferons in cerebral malaria	DBT	PI	54.0 (3 yrs, 2016-2019)	Deciphering the role of type I IFNs in protective immunity in a preclinical model of cerebral malaria, to understand pDC biology at the crossroads of autoimmunity and protective immunity
4	Exploring therapeutic efficacy of novel toll-like receptor 9 antagonists in type 2 diabetes	SERB	PI	50.0 (2 yrs, 2017-2019)	Pharmacokinetics, toxicity and preclinical efficacy of novel small molecule TLR9 antagonists in preclinical model of diet-induced obesity

INVITED TALKS

October 2016: Plenary Lecture, 14th International Symposium on Dendritic Cells, Shanghai, China.

November, 2016: Tata Translational Cancer Research Center, Tata Medical Center, Kolkata, India.

November, 2016: Annual Conference of Indian Rheumatology Association (West Bengal Chapter), Kolkata.

December, 2016: Plenary Lecture, 3rd International Meet on Advanced Studies in Cell Signaling Network (CeSiN 2016), CSIR-Indian Institute of Chemical Biology, Kolkata, India.

January, 2016: 8th East Zonal Oncology Symposium by Indian Association of Surgical Oncology, Saroj Gupta Cancer Center & Research Institute, Kolkata, India.

January, 2017: 14th Ann. Meeting of International Society of Heart Research Indian Section, Delhi, India.

February, 2017: 43rd Annual Conference of Indian Immunology Society, Vishakhapattanam, India.

March, 2017: Indian Association for Cultivation of Science, Kolkata, India.

Dr. Amitava Sengupta

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Chromatin remodeling in human myeloid leukemia

Participants

SRF: Shankha Subhra Chatterjee, Mayukh Biswas, Sayan Chakraborty, Liberalis Debraj Boila, Sayantani Sinha

Background

Stem cells possess two fundamental properties; self-renewal and differentiation. Bone marrow-resident adult hematopoietic stem cells (HSC) respond to physiological stimuli and regenerate hematopoiesis. Dysregulated self-renewal and arrest in differentiation of HSC and progenitors induce leukemic transformation. From a translational perspective HSCs draw attention because of their potential use in stem cell and gene therapy. We are trying to understand cell-autonomous and non-cell-autonomous molecular determinants that regulate HSC self-renewal, differentiation and interaction with hematopoietic microenvironment or niche in normal and leukemic hematopoiesis.

Aims and Objectives

- Cell-autonomous mechanisms of hematopoietic stem cell transformation
- Epigenetic regulation of leukemia stem cell heterogeneity

Work Achieved

We have addressed and identified, using cell and molecular biology, biochemistry and genetic *gain* and *loss of function* experiments, mechanistic underpinnings of dysregulated nucleosome remodeling, crosstalk with canonical histone modifying enzymes and intra-cellular heterogeneity in human myelodysplasia and acute myeloid leukemia. Our studies inform novel molecular therapeutic targets in human myeloid leukemia ***([1]Biswas M., [1]Chatterjee S.S. et al, in review; [1]Chatterjee S.S., [1]Biswas M. et al, in review; Boila L.D. et al, in review; [1]Mitra S., [1]Sinha S. et al, in review).***

Future Research Plans

Future research will be directed to identify, establish and functionally characterize epigenetic vulnerabilities embedded in human myeloid leukemia.

EXTRAMURAL FUNDING

Polycomb repressive complex in Myelodysplastic Syndromes, 2014-17, Department of Science & Technology (DST-SERB), Govt. of India.

Rho GTPase signaling in adult Hematopoietic stem cell-Microenvironment interaction, 2013-17, Department of Biotechnology-Ramalingaswami Fellowship, Govt. of India.

Deciphering Epigenetic Dysregulation in Hematopoietic Stem Cell Transformation in Human Myelogenous Leukemia, Department of Biotechnology (DBT), Govt. of India *(recommended).*

Understanding hematopoietic stem cell aging in leukemia, Indian Council of medical Research (ICMR), Govt. of India *(recommended).*

Targeted hematopoietic stem cell engineering for sickle cell anemia therapy, Council of Scientific & Industrial Research-Mission Mode Program (CSIR-MMP), Govt. of India *(recommended).*

CONFERENCES / WORKSHOPS

Number of abstracts

International: 1

INVITED TALKS

Hematopoietic stem cell-microenvironment interaction. 6th Ramalingaswami Fellow's Conclave, Indian Institute of Science Education & Research (IISER), January 2017, Pune, India.

Epigenetics in myeloid leukemia: Benchworker's perspective., Bengal Society of Hematology (BSH), December 2016 Kolkata, India.

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Influence of lipid core material on physicochemical characteristics of an Ursolic acid-loaded nanostructured lipid carrier: an attempt to enhance anticancer activity

Participants

SRF: Samrat Chakraborty, Nilanjana Deb

Collaborator(s)

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Prof. Amia Panda
Vidyasagar University, Midnapore

Prof. Biswajit Mukherjee & Prof. Tarun Jha
Jadavpur University, Kolkata.

Collaborators within CSIR-IICB

Dr. Snehashikta Swarnakar
Cancer Biology & Inflammatory Disorder Division

Dr. P. Jaishankar & Dr. Chinmay Chowdhury
Organic & Medicinal Chemistry Division

Background

Nanotechnology refers to the creation and utilization of materials whose constituents exist at the nanoscale; and, by convention, be up to 100 nm in size. It has the potential to revolutionize a series of medical and biotechnology tools and procedures so that they are portable, cheaper, safer, and easier to administer. Nanoparticles are being used for diverse purposes especially in the treatment of cancers due to their unique properties like size, surface charge and surface are, sustained action for better therapeutic outcome and patient's compliance. Moreover, the surfaces of the nanopariticle can be decorated with various ligands in order to achieve targeted therapy towards cancerous cell, thus proving no untowards effects to the healthy cells. Nanoparticle technologies have great potentials, being able to convert poorly soluble, poorly absorbed and labile biologically active substance into promising deliverable substances. Ursolic acid (UA, 3β-hydroxy-urs-12-en-28-oic acid), a natural pentacyclic triterpenoid found in different plant species, possesses a wide range of bioactivities, viz., antitumor, anti-inflammatory, antioxidant, antibacterial, antiviral, and hepatoprotective effects. Recent studies have shown that UA has potential antitumor effects and cytotoxic activity toward various types of cancer cell lines. In spite of such potential, the clinical application of UA is limited because of its poor aqueous solubility, resulting in its low bioavailability and poor *in vivo* pharmacokinetics.

Aims and Objectives

- The aim is to explore the potential of anticancer natural/synthetic compound and their delivery strategies. Nanotechnology hhas great potentials, being able to convert poorly soluble, poorly absorbed and labile biologically active substance into promising deliverable substances.
- The impact of saturation and unsaturation in the fatty acyl hydrocarbon chain on the physicochemical properties of nanostructured lipid carriers (NLCs) was investigated to develop novel delivery systems loaded with an anticancer drug, ursolic acid (UA).

Work Achieved

The impact of saturation and unsaturation in the fatty acyl hydrocarbon chain on the physicochemical properties of nanostructured lipid carriers (NLCs) was investigated to develop novel delivery systems loaded with an anticancer drug, ursolic acid (UA). Aqueous NLC dispersions were prepared by a high-pressure homogenization-ultrasonication technique with Tween 80 as a stabilizer. Mutual miscibility of the components at the air-water interface was assessed by surface pressure-area measurements, where attractive interactions were recorded between the lipid mixtures and UA, irrespective of the extent of saturation or unsaturation in fatty acyl chains. NLCs were characterized by combined dynamic light scattering, transmission electron microscopy (TEM), atomic force microscopy (AFM), differential scanning calorimetry, drug encapsulation efficiency, drug payload, in vitro drug release, and in vitro cytotoxicity studies. The saturated lipid-based NLCs were larger than unsaturated lipids. TEM and AFM images revealed the spherical and smooth surface morphology of NLCs. The encapsulation efficiency and drug payload were higher for unsaturated lipid blends. In vitro release studies indicate that the nature of the lipid matrix affects both the rate and release pattern. All UA-loaded formulations exhibited superior anticancer activity compared to that of free UA against

human leukemic cell line K562 and melanoma cell line B16. Conclusively, both saturated and unsaturated lipid-containing NLCs formulated in this study may be used as potential delivery systems for UA with improved anticancer activity.

Future Research Plans

To establish the potential PLGA nanoparticle encapsulating the anticancer compound *in-vitro* as well as *in-vivo*.

To establish the potential of different natural compounds as immuno stimulating and as anticancer.

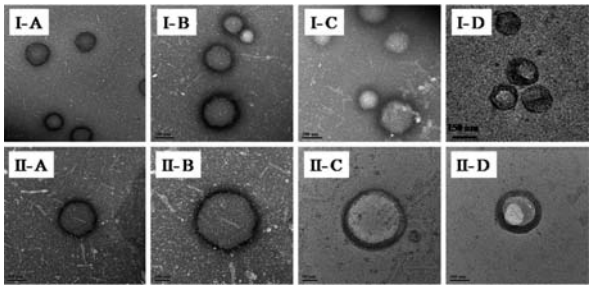

Fig. 1: TEM images of (A) TB/HSPC/BA, (B) TB/HSPC/OA, (C) TE/HSPC/BA, and (D) TE/HSPC/OA NLC formulations. I and II denote blank NLCs and ursolic acid-loaded NLCs, respectively.

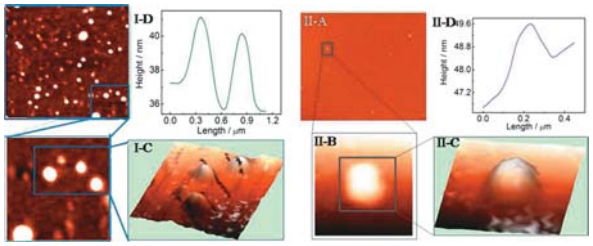

Fig. 2: Representative AFM images of (I) TB/HSPC/BA and (II) TE/HSPC/OA NLC formulations. (A and B) Two-dimensional images, (C) three-dimensional images, and (D) and section analysis.

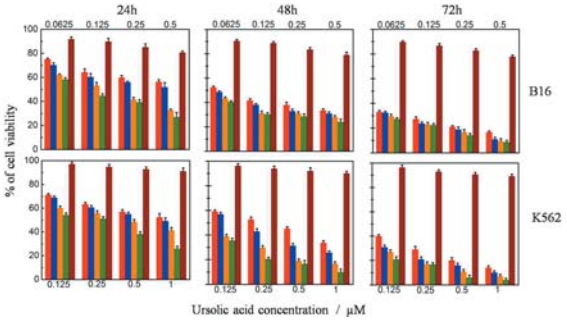

Fig. 3: *In-vitro* cytotoxicity activity of free ursolic acid (brown) and ursolic acid loaded with different NLCs, TB/HSPC/BA (red), TB/HSPC/OA (blue), TE/HSPC/BA (orange), and TE/HSPC/OA (green), on the viability of B16 and K562 cells. Cells were grown and treated for 24, 48, and 72h. Experiments were performed in triplicate, with the results showing the mean and standard deviation of the triplicate of each group. The experiments were repeated three times with similar results.

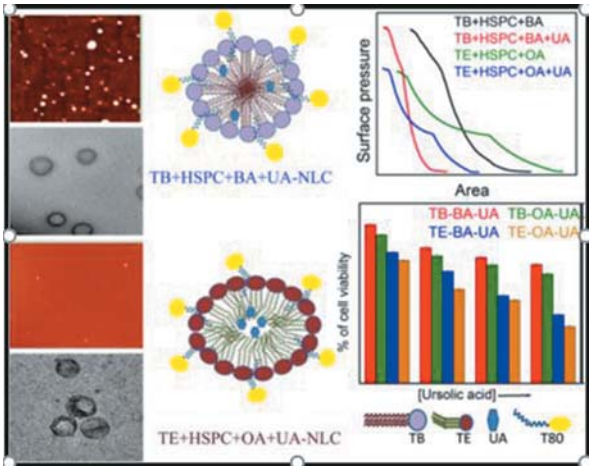

Fig. 4: Schematic diagram of the overall work done.

PUBLICATIONS

Nahak P., Karmakar G., Chettri P., Roy B., Guha P., Besra S.E., Soren A., Bykov A.G., Akentiev A.V., Noskov B.A. and Panda A.K. (2016) Influence of lipid core material on physicochemical characteristics of an Ursolic acid-loaded nanostructured lipid carrier: An attempt to enhance anticancer activity. *Langmuir* **32,** 9816-9825

Ray M., Adhikari A., Sur T.K., Besra S.E., Biswas S. and Das A.K. (2016) Evaluation of anti-inflammatory potential of ethanolic extract of the leaves of *rhizophora mucronata,* a sunderban mangrove. *Int Jour Res Develop Phar Life Sciences.* **6,** 2506-2516

Dutta S., Deb N., Pattnaik A.K. and Besra S.E. (2016) Apoptosis inducing potential of *lawsonia alba* lam. leaves on hepatocellular carcinoma (Hep-G2) cells along with its anti-oxidant property. *Inter Jour Phar Pharmaceutical Science* **8,**155-162.

CONFERENCES / WORKSHOPS

Number of abstracts India: 7

INVITED TALKS

Cytotoxic and apoptosis inducing activity of secretion of Bellamya bengalensis on cancer cells; Department of Molecular Biology and Biotechnology, Tejpur University; National Seminar on Snake Venom Research and Snake Bite Therapy: National and International Perspective (SnakSymp2016) & Annual meeting of Toxinological Society of India; November 2016, Tejpur, Assam, India.

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Protective role of engineered nanoparticles in inflammatory diseases

Participants

JRF: Sujata Das, Tanushree Das, Sayoni Nag, Saheli Roy, Moumita Saha

SRF: Dipayan Bose

RA: Dr. Krishnendu Manna

Project fellow: Mr. Snehasis Mishra, Saswati Banerjee

Collaborator(s)

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Dr. Chittaranjan Sinha
Jadavpur University, Kolkata

Dr. Joydev Dind
Utkal University, Odisha

Dr. Debasish Maity
Tripura University, Tripura

Dr. Rajkumar Duary
Tezpur University, Assam

Dr. R. K. Pal
National Research Centre on Pomegranate, Solapur, Maharashtra

Collaborators within CSIR-IICB

Dr. P. Jaisankar, Dr. Biswadip Banerji & Dr. Arindam Talukdar
Organic & Medicinal Chemistry Division

Background

Nanoparticles have emerged as improved targeted efficacious drug delivery option for the diagnosis and treatment of a variety of diseases. Magnetic nanoparticles are a major class of nanoscale materials effective for diagnostic and therapeutic purposes. Gold nanoparticles (AuNPs) are being equally important as non-toxic carriers and improved delivery of drugs for its favourable physical and biochemical properties.

Aims and Objectives

- Preparation of target specific magnetite nanoparticles of anticancer agents coated with polymer for theranostic purposes and examination of its theranostic efficacy.
- Preparation of gold nanoparticles of natural compounds and examination of its protective efficacy against organ damage

Work Achieved

We have prepared a folic acid conjugated PLGA coated magnetite nanoparticles of andrographolide, characterized and examined its theranostic effect against colon cancer cell line. AFM and DLS of Figure 1 show that the nanoparticle has been constructed successfully with size of nearly 60nm. Higher cellular uptake of the folic acid conjugated magnetite nanoparticles is observed (higher dark region) in colon cancer cell line, HCT116 unlike normal kidney cell, HEK237 where low uptake is seen in **Fig. 1,** MRI). Confocal microscopy study in Figure 1 shows that the nanoparticle suppresses the survival factor AKT and heat shock protein 70 (HSP70) those are highly expressed in colon cancer cells.

Gold nano particle of pomegranate peel extracts (PPE-AuNP) prepared having particle size 20nm (upper panel of **Fig. 2**) shows good renoprotective effect in diabetes model. Lower panel of Figure 2 shows that treatment of PPE-AuNP reduces the anomalies like capillary constriction leading to increased interstitial space, mesangial expansion, higher collagen deposition and infiltration of inflammatory cells seen in streptozotocin-induced diabetic kidney.

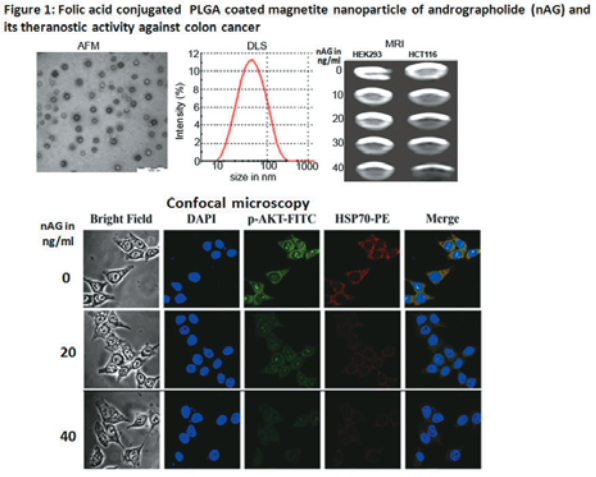

Fig. 1: Folic acid conjugated PLGA coated magnetite nano particle of andrographolide and its theranostic activity against colon cancer cell line

Future Research Plans

Theranostic efficacy of the nanoparticles will be examined in animal model.

Pharmacokinetics of the drug such as biodistribution, metabolism, and elimination of drugs from the body will be examined.

Other types of nanoparticles like drug loaded mesoporous nanoparticles will be designed.

PUBLICATIONS

Suvarna S., Das U., Kc S., Mishra S., Sudarshan M., Saha K.D., Dey S., Chakraborty A. and Narayana Y. (2017) Synthesis of a novel glucose capped gold nanoparticle as a better theranostic candidate. *PLoS One* **12,** e0178202

Nandi R., Mishra S., Maji T.K., Manna K., Kar P., Banerjee S., Dutta S., Sharma S.K., Lemmens P., Saha K.D. and Pal S.K. (2017) A Novel nanohybrid for cancer theranostics: folate sensitized fe2o3 nanoparticle for colorectal cancer diagnosis and photodynamic therapy *Journal of Materials Chemistry B,* Jan DOI: 10.1039/C6TB03292C

Nandy A., Samanta T., Mallick S., Mitra P., Seth S.K., Saha K.D., Al-Deyabe S.S. and Dinda J. (2016) Synthesis of gold(iii)←gold(i)-nhc through disproportionation: role of gold(i)-nhc in the induction of apoptosis in hepg2 cells. *New Journal of Chemistry,* May, DOI:10.1039/C5NJ02979A

EXTRAMURAL FUNDING

Utilization of promegranate for development of functional medical ingredients. Start date: 29-12-2016 (3 years). NMPB-AYUSH, India

Designing bioactive peptides from whey liquid waste of the dairy industry: Functionality and health benefit in Obesity, Obesity associated disorders with exploration of molecular mechanism. Start date- 02.01.2017 (3 years). DBT-NER, India.

Mechanistic study of effect of Spergulin-A extracted from Glinus oppositifolius on macrophages to raise anti leishmanial host defense. Start date- 14.03.2016 (3 years). DST-SERB, India.

Modulatory role of quercetin on radiation-induced oxidative stress in human colorectal carcinoma cells: Assessment of possible role of certain trace elements. Start date-01.12.2015 (3 years). UGC-DAE, India.

Studies on anticancer activities of extracts (Bromelain and Peroxidase) of different pineapple (Ananas comosus) cultivars of Tripura. Start date- 18.03.2014 (3 years). DBT-NER, INdia.

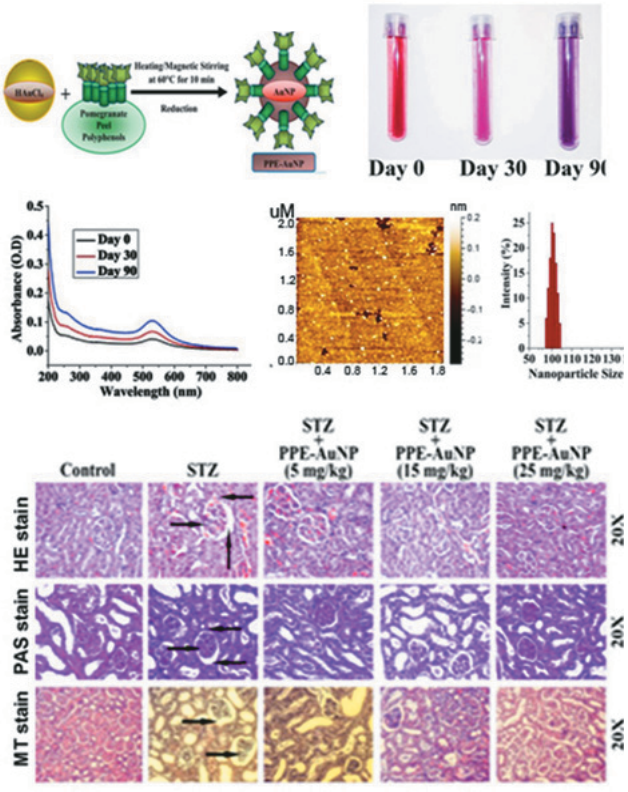

Fig. 2: Gold nanoparticles of pomegranate peel extract and its renoprotective effect

Organic and Medicinal Chemistry Division

Dr. G. Suresh Kumar, Dr. P. Jaisankar (Head), Dr. Chinmay Chowdhury, Dr. Sharmila Chattopadhya, Dr. Biswadip Banerji, Dr. Surajit Ghosh, Dr. Indrajit Das, Dr. Sanjay Dutta, Dr. Ranjan Jana, Dr. Arindam Talukdar, Dr. R. Natarajan, Dr. Indu Bhusan Deb and Dr. Saraswati Garai

The Organic and Medicinal Chemistry Division - wherein novel designer and functional molecules are being synthesized at will - is the major backbone of the institute. The scientists of this division, in active collaboration with other scientists of the institute, strive to develop drugs and diagnostics for infectious diseases, neuronal diseases, cancer and other ailments. The division has a strong and proven track record of developing natural product based drugs 'Asmon' and 'Prostalyn' currently in the market. The divisional scientists are making a sincere stride in translational research to solve the healthcare issues of national importance.

The major research themes pursued in the division include isolation of medicinally active natural products from indigenous plants for drug formulation; development of synthetic analogues of bioactive phytochemicals as lead molecules for drugs through structure-activity relationship studies; genetic manipulation of phytoceuticals for better medicinal benefits; development of lead molecules from structure-based drug design; design and synthesis of 'new chemical entities' to examine their biological/biophysical efficacy towards 'new therapeutic entities'; development of economic and efficient reagents for essential and innovative synthetic transformations to obtain heterocyclic bioactive molecules; development of novel chiral and achiral catalytic systems for various organic transformation of functional groups and C-H activation strategies for synthesis to obtain functional molecules, especially, fluorescent and multifunctional molecular probes for affinity based protein profiling; development of novel synthetic methodologies for bioconjugation; design and synthesis of novel synthetic supramolecular receptors of organic and metal-organic in nature to study biomolecular recognition and controlled release; targeting nucleic acids, bacterial and viral RNAs by small molecule natural products and heterocycles; development of small molecules, peptides and peptoids for neurodegenerative diseases; development of small molecules based antibiotics against various resistant bacteria; development of various platforms for studying bio-molecular interactions through surface modification and patterning using liposomes; and, development of peptide-based soft hydrogel for various biomedical applications.

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Nucleic acid and protein interaction by plant alkaloids and small molecules

Participants

SRF: Soumitra Hazra,Pritha Basu, Sabyasachi Chatterjee, Baishakhi Saha

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WOS: Srabanti Kumar

NPDF: Urmila Saha

Technician: Jishu Mandal

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Collaborators outside CSIR-IICB

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Dr. J.P. Naskar
Department of Chemistry Jadavpur University, Kolkata

Collaborator within CSIR-IICB

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Structural Biology & Bioinformatics Division

Background

The binding of small molecule alkaloids, dyes and drugs to nucleic acids is an important area to understand the molecular aspects of the interaction. This data is required to develop them as nucleic acid targeted drugs. Furthermore, their binding to fucntional and carrier proteins need to be understood to understand their efficacy in delivering them to specific sites. In order to develop natural product alkaloids and related molecules as therapeutic agents. We studied the interaction of a number of small molecule alkaloids, their nalogs and other dyes and drugs to nucleic acids and many functional proteins.

Aims and Objectives

- Study the structural aspects of plant alkaloids, dyes and small molecules with RNA, DNA and proteins
- Elucidate the thermodynamics of the interaction
- Correlate the strucutral aspects with energetic data

Work Achieved

This laboratory has been elucidating the structural and thermodynamic aspects of small molecules like natural alkaloids, synthetic alkaloids, dyes and other molecules with nucleic acids and proteins. The sudies included drug-duplex, triplex and quadruplex interactions, nano-bio interaction, interaction of copper complexes, metal oxides, phenazinium and phenathazinium dyes, metal nanoparticles etc. The major idea of this study is to develop therapeutic agents specifically targeted to the biomoleules in the cell after understanding their invitro behaviour through extensive biophysical studies.

Our strategy involved spectroscopic studies using absorption, fluorescence and circular dichroism studies and also calorimetric studies with isothermal and differential scanning calorimetry tools.

Overall new data on the interaction of a vide variety of small molecules to nucleic acid strucutres, and many functional proteins have been advanced potentiating their application for theraputic advantage.

Future Research Plans

Invivo studies on the interaction of alkaloids and other small moleucles with various nucleic acids and poly (A) for drug development will be pursued.

PUBLICATIONS

Basu P. and Suresh Kumar G. (2017) Small molecule–RNA recognition: Binding of the benzo-phenanthridine alkaloids sanguinarine and chelerythrine to single stranded polyribonucleotides *J. Photochem. Photobiol. B Biol* **174,** 173-181.

Basu A. and Suresh Kumar G. (2017) Interaction and inhibitory influence of the azo dye carmoisine on lysozyme amyloid fibrillogenesis. *Mol Biosyst* **13,** 1552-1564.

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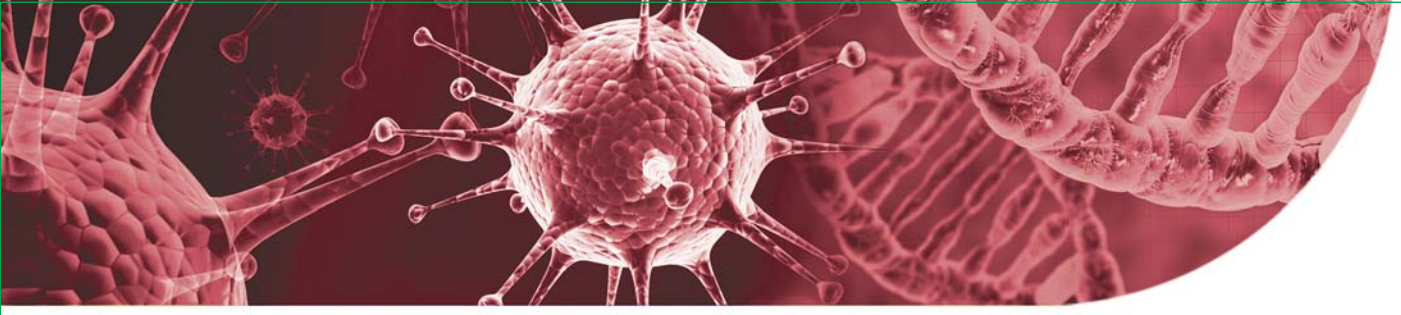

binding aspects of a trinuclear copper (II) complex having a Cu_3O core. *Inorg. Chim. Acta* **462,** 158-166

Chakraborty I., Saha U., Rakshit R., Talukdar S., Suresh Kumar G. and Mandal K. (2017) Design and development of bioactive α-hydroxy carboxylate group modified $MnFe_2O_4$ nanoparticles. Comparative fluorescence study, magnetism and DNA nuclease activity. *Materials Today Chemistry* **5,** 92-100

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Paul P., Mati S.S., Bhattacharya S.C. and Suresh Kumar G. (2016) Exploring the binding interaction of phenothiazinium dyes methylene blue, new methylene blue, azure A and azure B to $tRNA^{phe}$: Spectroscopic, thermodynamic, voltammetric and molecular modelling approach. *Phys Chem Chem Phys* **19,** 6636-6653

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Guhathakurta B., Basu P., Purohit C.S., Bandyopadhyay N., Suresh Kumar G., Chowdhury S. and Naskar J.P. (2017) Synthesis, characterization, structure, DNA binding aspects and molecular docking study of a novel Schiff base ligand and its bis(μ-chloro) bridged Cu(II) dimer. *Polyhedron* **126,** 195-204

Das S., Pramanik S., Chatterjee S., Das P.P., Devi P.S. and Suresh Kumar G. (2017) Selective Binding of Genomic Escherichia coli DNA with ZnO Leads to White Light Emission: A New Aspect of Nano-Bio Interaction and Interface. *ACS Appl Mater Interfaces* **9,** 644-657

Saha B. and Kumar G.S. (2017) Binding interaction of phenothiazinium dyes with double stranded RNAs: Spectroscopic and calorimetric investigation. *J Photochem Photobiol B* **167,** 99-110

Mukhopadhyay S., Maiti D., Chatterjee S., Devi P.S. and Suresh Kumar G. (2016) Design and application of Au decorated ZnO/TiO_2 as a stable photocatalyst for wide spectral coverage. *Phys Chem Chem Phys* **18,** 31622-31633.

Chatterjee S. and Suresh Kumar G. (2016) Visualization of stepwise drug-micelle aggregate formation and correlation with spectroscopic and calorimetric results. *J Phys Chem B* **120,** 11751-11760

Kabir A., Dutta D., Mandal C. and Suresh Kumar G. (2016) Molecular recognition of tRNA with spermine, 1-naphthyl acetyl spermine and spermidine: A comparative biophysical, thermodynamic and molecular docking investigation. *J Phys Chem B* **120,** 10871-10884

Basu A. and Suresh Kumar G. (2016) Molecular recognition of lysozyme by food colorants amaranth and tartazine: Insights into macromolecular aggregation from biophysical studies. *J Photochem Photobiol B Biology* **165,** 42-50

Kumar S., Bharitkar Y.P., Suresh Kumar G and Mondal N.B. (2016) Asiatic acid, a non-detergent type spermicide: Exploration of plausible pathway of spermicidal action. *Med Chem Res* **25,** 1908-1915

Khan A.Y. and Suresh Kumar G. (2016) Anticancer drug topotecan binds to human hemoglobin: Structural and thermodynamic results. *J Photochem Photobiol B Biology* **163,**185-193

Maity P., Saha B., Suresh Kumar G and Karmakar S. (2016) Effect of counterions on the binding affinity of Na^+ ion with phospholipid membranes. *RSC Adv* **6,** 83916-83925

Paul P., Mati S.S., Bhattacharya S.C. and Suresh Kumar G. (2016) Spectroscopic, calorimetric, cyclic voltammetric and molecular modeling studies of new methylene blue poly adenylic acid interaction and comparison to thionine and toluidine blue O: Understanding self-structure form ation by the planar dyes. *Dyes Pigments* **136,** 205-218

Basu P., Basu A. and Suresh Kumar G. (2016) Binding of the putative anticancer agent chelerythrine to double stranded poly(A): Calorimetry and spectral characterization studies, *J Chem Thermody.* **103,** 228-233

Basu A. and Suresh Kumar G. (2016) Insights into the toxicity of food colorants: Multispectroscopic and calorimetric studies on the binding of the food colorant tartrazine with human hemoglobin. J. *Haz. Mater* **318,** 468-476

Basu A. and Suresh Kumar G. (2016) Coralyne induced self-structure in polyadenylic acid: Thermodynamics of the structural reorganization, *J Chem Thermodyn* **101,** 221-226

Pramanik S., Chatterjee S., Saha A., Devi P.S. and Suresh Kumar G. (2016) A label free detection of double stranded DNA using silver nanoparticles. *J Phys Chem B* **120,** 5313-5324

Basu P., Payghan P.V., Ghoshal N. and Suresh Kumar G. (2016) Structural and thermodynamic analysis of the binding of tRNA(phe) by the putative anticancer alkaloid chelerythrine: Spectroscopy, calorimetry and molecular docking studies. *J Photochem Photobiol B* **161,** 335-34.

Saha B. and Kumar G.S. (2016) Spectroscopic and calorimetric investigations on the binding of phenazinium dyes safranine-O and phenosafranine to double stranded RNA polynucleotides. *J Photochem Photobiol B* **161,** 129-140.

Book Chapters / Invited Reviews

Basu P. and Suresh Kumar G. (2017) Sanguinarine and its role in chronic diseases. in Anti-Inflammatory Nutraceuticals and Chronic Diseases. Vol 928, of the series 155-172. Edited by S. C. Gupta, S. Prasad and B. B. Aggarwal. Springer International Publishing AG, Switzerland.

AWARDS / HONOURS / MEMBERSHIPS

Dr. G. Suresh Kumar

Fellowship of the Royal Society of Chemistry (FRSC)

Dr. Parasuraman Jaisankar

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Asymmetric synthesis of organic molecules using enzyme and organo catalysts and study of their physical, chemical and biological properties

Participants

JRF: Vivek K.Gupta

SRF: Rahul Gajbhiye, Sourav Chatterjee

N-PDF: Dr. Sreya Gupta

RA: Dr. Chiranjit Acharya

Project Assistant: Pinaki Bhattacharjee, Anushree Achari

Background

Enantioselective organic transformations remain one of the most exciting and challenging tasks in the realm of organic chemistry. Bio-catalytic approach which mainly focuses on harnessing enzyme catalytic activity to develop novel methodology and alternative chemical transformations is a new arena in organic synthesis, attracting much attention of the researchers and expanding rapidly in recent years. Bio-catalytic systems have got advantages of economically viable, ecologically beneficial and more sustainable than current chemical technologies, due to their inherent advantages of higher selectivity, milder conditions and comparatively cheaper resources. The only limiting factor of enzymes is their specificity towards the substrate. Therefore, searching for new enzymes from easily available natural sources such as edible vegetables is an important task in the field of asymmetric organic synthesis.

Aims and Objectives

- Our main objective is to investigate the catalytic activity of enzyme isolated from *Daucus carota* root towards asymmetric cross aldol reaction of aromatic aldehydes and acetone in aqueous medium.
- Another objective of our project is to investigate the catalytic activity of a new chiral organo catalyst towards asymmetric Friedel-Crafts alkylation.

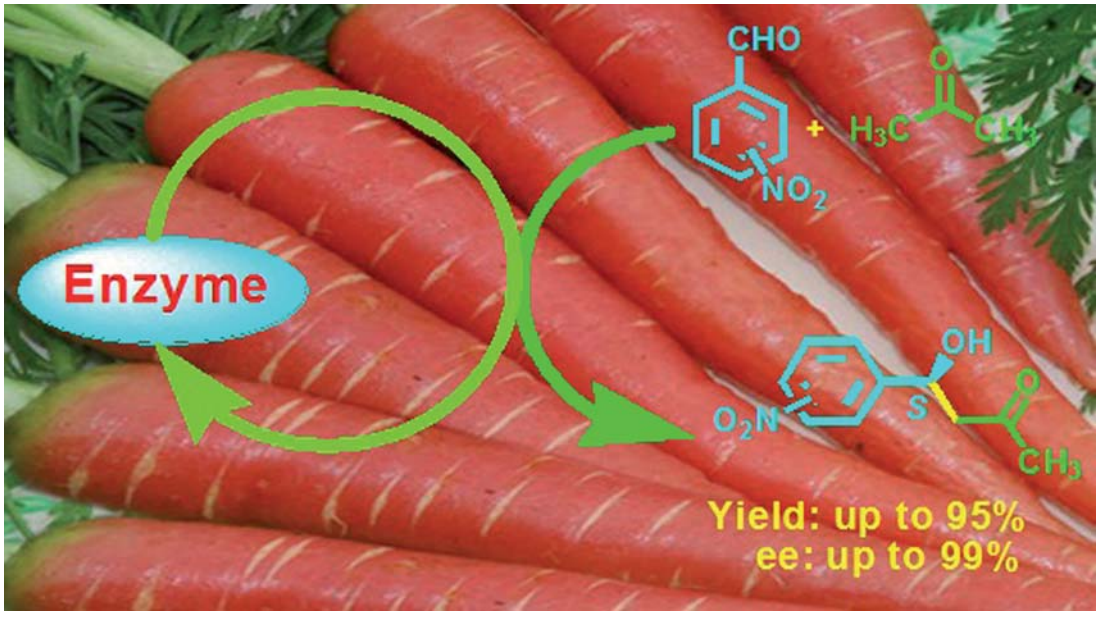
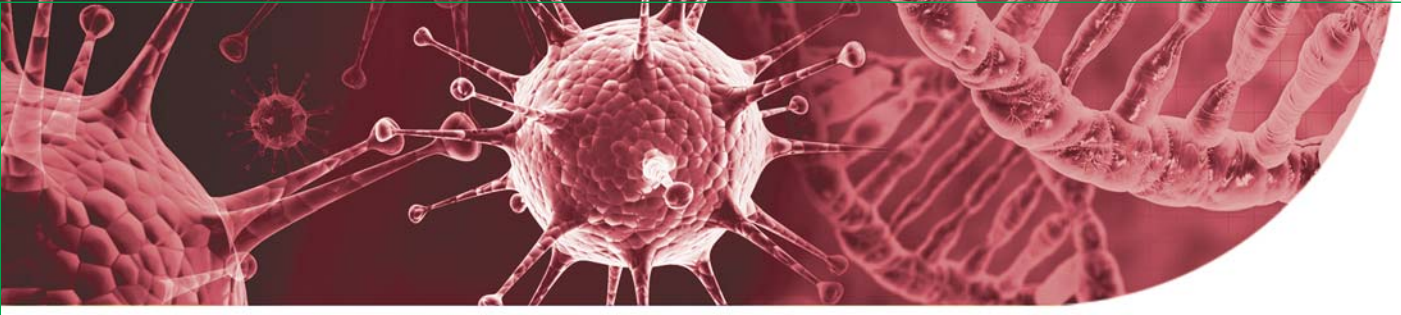


Fig. 1: Enzyme from *Daucus carota* root catalyzed asymmetric cross aldol reaction.



Work Achieved

In the present study a novel enzyme has been isolated from *Daucus carota* root and it's catalytic activity has been investigated towards asymmetric cross aldol reaction of aromatic aldehydes with acetone in aqueous medium to afford cross aldol products with excellent yield (up to 95%) and enantioselectivity (up to 99%). This work has been accepted and published as cover page article in Tetrahedron letters.

Future Research Plans

We have established that enzyme from *Daucus Carota* root catalyzes asymmetric cross aldol reaction. Investigation on catalytic application of chiral organic Brønsted acid towards asymmetric Friedel-Crafts alkylation is ongoing project which involves the synthesis of Fiaud's acid (trans-1-hydroxy-2,5-diphenylphospholane 1-oxide) and its application as an efficient chiral Brønsted acid catalyst in asymmetric Friedel-Crafts alkylation of indoles with 2-butene-1,4-diones.

Reference: Acharya C, Mandal M, Dutta T, Ghosh AK, Jaisankar P. (2016) Enzyme from *Daucus carota* root catalyzed asymmetric cross aldol reactions. *Tetrahedron Lett.* **57,** 4382-4385.

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Gupta S.J., Dutta S., Gajbhiye R.L., Jaisankar P. and Sen A.K. (2017) Synthesis, in vitro evaluation and molecular docking studies of novel amide linked triazolyl glycoconjugates as new inhibitors of alpha-glucosidase. *Bioorg Chem* **72,** 11-20

Vinayagam J., Gajbhiye R.L., Mandal L., Arumugam M., Achari A. and Jaisankar P. (2017) Substituted furans as potent lipoxygenase inhibitors: Synthesis, in vitro and molecular docking studies. *Bioorg Chem* **71,** 97-101.

Gorain B., Choudhury H., Tekade R.K., Karan S., Jaisankar P. and Pal T.K. (2016) Comparative biodistribution and safety profiling of olmesartan medoxomil oil-in-water oral nanoemulsion. *Regul Toxicol Pharmacol* **82,** 20-31.

Acharya C., Mandal M., DuttaT., Ghosh A.K., Jaisankar P. (2016) Enzyme from *Daucus carota* root catalyzed asymmetric cross aldol reactions. *Tetrahedron Lett.* **57,** 4382-4385.

Saha S., Acharya C., Pal U., Chowdhury S.R., Sarkar K., Maiti N.C., Jaisankar P. and Majumder H.K. (2016) A Novel Spirooxindole Derivative Inhibits the Growth of Leishmania donovani Parasites both In Vitro and In Vivo by Targeting Type IB Topoisomerase. *Antimicrob Agents Chemother* **60,** 6281-6293.

BOOK CHAPTER(S) / INVITED REVIEWS:

Tathagata Sengupta, Jayram Vinayagam, Raghabendra Singh, Parasuraman Jaisankar and K. P. Mohanakumar (2016) Plant-Derived Natural Products for Parkinson's Disease Therapy: The Benefits of Natural Products for Neurodegenerative Diseases. Advances in Neurobiology Biology. *Human Press, Springer publishing group, USA, (Ed. Dr. John Walker) Vol. 12, pp. 12:415-96.*

AWARDS / HONOURS / MEMBERSHIPS

Dr. P. Jaisankar

Dr. B. Mukherjee Memorial oration award: by Indian Pharmacological Society (IPS),

INVITED TALKS

A green look on asymmetric aldol reaction catalyzed by Daucus carota root. National Conference on Green Chemistry and Sustainable Environment (GCSE – 2016), B.S. Abdur Rahman University, 2-3 August, 2016, Chennai

3, 3'-Diindolylmethane (DIM) as potent anti-leishmanial agent targeting DNA topoisomerase 1B of Leishmania Donovani. International Indo-Brazil Symposium on "Biochemistry of Kinetoplastid Parasites" organized by CSIR-IICB, , 19 - 20 September, 2016, Kolkata.

Development of efficient hybrid polymer based nano-structured lipid carrier (NLC) for enhanced activity of orcinol glycoside (OG) against gastrointestinal cancer cell lines. "104th Indian Science congress" ISCA during 3-7th January, 2017, Tirupati.

A novel spirooxindole derivative inhibits the growth of Leishmania donovani parasite both in vitro and in vivo by targeting type IB topoisomerase. 5th International conference on molecular signalling: Basics to applications, Anna University,. 10-12th January, 2017, Chennai

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Palladium-catalyzed synthesis of novel heterocycles of biological interests

Participants

JRF: Subhendu Pramanik

SRF: Priyanka Kundu, Moumita Jash, Amrita Mondal

Collaborator(s)

Collaborator outside CSIR-IICB

Dr. Santanu Paul
University of Calcutta

Collaborator within CSIR-IICB

Dr. Shila E. Besara
Cancer Biology & Inflammatory Disorder Division

Background

Quinazolin-4(3H)-one constitutes an important class of heterocycles being an integral part of a large number of naturally occurring alkaloids (~150) and drug candidates. It exhibits a broad range of biological activities such as anticancer, antiviral, antimalarial, antifungal and human microsomal prostaglandin synthase 1 (mPGES-1) inhibitor.The 2-styryl derivatives are considered as privileged structures in medicinal chemistry because of their promising pharmacological effects. In recent past, a quinozoline derivative having a β-styryl unit (at C2 position) was developed as a lead candidate (*J.Am.Chem.Soc.* 2015, 137, 17380) by screening a large numbers of compounds as it showed remarkable *in vitro* and *in vivo* (methicillin-resistant *Staphylococus aureus* mouse model) efficacy with improved pharmacokinetics.

On the other hand, Carbazoles prevalent in many naturally occurring alkaloids have gained considerable attention in recent times due to their diverse biological and unique optical properties. In particular, benzo[a]carbazoles display a broad range of activities including anti-inflammatory, anti-estrogenic, anti-fungal, and kinase inhibitory and are also utilized in other fields such as development of light emitting diodes (LEDs), dye sensitized solar cells (DSSC) and fluorescent reagents.

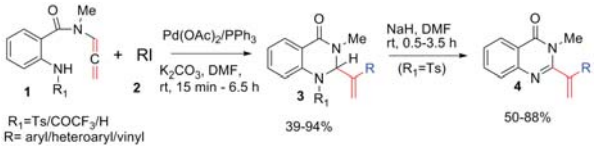
Aims and Objectives

- To find out convenient palladium-catalyzed method for synthesis of 2,3-dihydroquinazolin-4(1H)-ones .
- To find a straightforward reaction strategy for the conversion of 2,3-dihydroquinazolin-4(1H)-ones to 2-(α-styryl)quinazolin-4(3H)-ones (a regioisomer of the β-styryl counterpart) and their benzothiadiazine-1,1-dioxide analogs which could serve as important pharmacophores in drug discovery.
- To develop a palladium catalyzed cascade reaction wherein in situ heteroannulation followed by carboannulation may lead to the formation of benzo[a]carbazoles in one pot.

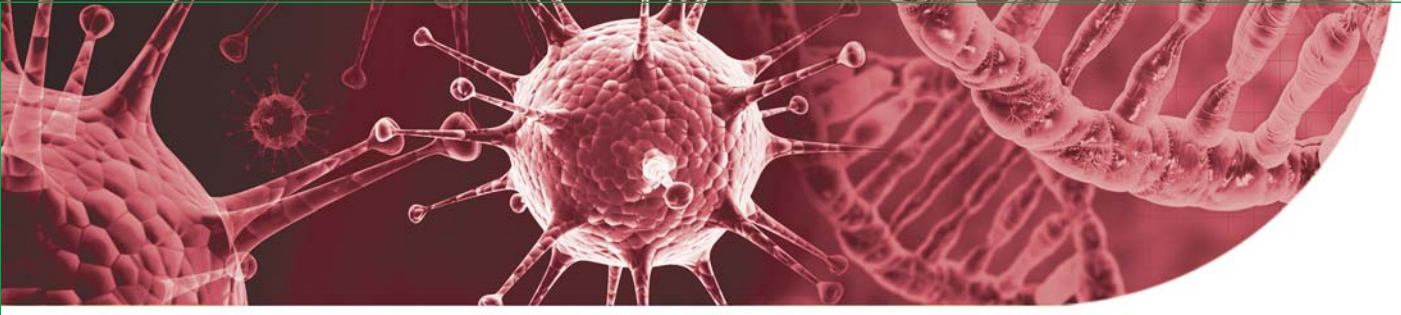
Work Achieved

An efficient two-step synthetic route for 2-(α-styryl)quinazolin-4(3*H*)-ones **4** has been achived (Scheme 1). Toward this objective, initially, anthranillic allenamide **1** reacted successfully with a series of aryl/heteroaryl/vinyl iodides **2** in the presence of $Pd(OAc)_2/PPh_3$ and potassium carbonate furnishing 2-(α-styryl)-2,3-dihydroquinazolin-4-ones **3** with moderate to excellent yields.

Irrespective of the substitution, all aryl iodides **2** possessing either electron donating (viz., Me, OMe) or withdrawing group (viz., CF_3, CHO, CO_2Me, NO_2) efficiently participated in this reaction yielding (67-86%) the products **3** within 2.5 h (Scheme 1). Besides, olefinic iodides were also found to be reactive under the reaction conditions. Unfortunately, neither any aryl bromide/chloride nor allenamide without *N*-alkylation reacted. The reactivity of trifluoroacetanilide substituted allenamide **1** towardsaryl iodides was also explored. Interestingly, this gave direct access to the N-deprotected products **3.** Even allenamide **1** containing free amine moiety participiated the reaction resulting in the formation of the corresponding products **3.** Thereafter, we sought a base promoted conversion of products **3** to

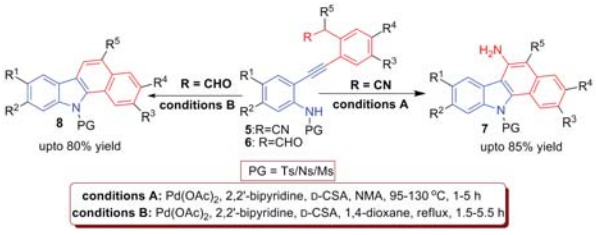


Scheme 1: Synthetic route for 2-(α-styryl)quinazolin-4(3H)-ones **4**



2-(α-styryl)quinazolin-4(3*H*)-ones **4.** After screening a series of bases and different solvent systems, sodium hydride (NaH) and DMF appeared to be the best. Thus, substrates **3** (R_1=Ts) containing functionlized aryl/heteroaryl group in the styryl moiety afforded products **4** in very good yields (60-87%). Furthermore, this reaction has also been applied in the synthesis of the analogs of a naturally occurring alkaloid isolated from the aerial parts of the *Peganum nigellastrum* Bunge which have applications in the Chinese system of medicines.

Besides, Pd(II) catalyzed direct synthesis of benzo[α]carbazoles has been achieved (Scheme 2). In order to achieve the conversion of amino-alkyne **5** to benzo[α]carbazole **7**, we found out an optimized reaction conditions [$Pd(OAc)_2$/ 2,2'-bipyridine/ D-CSA/ NMA] after screening a series of palladium catalyst, ligands, additives and solvent systems. Indeed, an array of useful functional groups



Scheme 2: Palladium-catalyzed synthesis of Benzo[α]cabazole derivatives **7** and **8**

(viz., Me, CF_3, OMe, CO_2Me, F, Br) was found to be compitable in this reaction. For the substituent R^1 (para to the amine group) in the amino aryl moiety of substrate **5,** an electron-donating group (EDG) like methyl or methoxy afforded the corresponding benzo[α]carbazoles in 72-77% yield (Scheme 2). Whereas an electron-withdrawing group (R^1=Br/F/CF_3) in the same position furnished the corresponding product in somewhat lower (60-70%) yields. Of the substituents (R^3, R^4) in the other benzene ring, electron donor groups allowed the reaction to be carried out at lower temperature (95 ºC) and in a shorter time (1-1.2 h). In contrast, electron-withdrawing group (e.g., CO_2Me, CF_3) introduced in the same position of substrate **5** distinctly lowered the yields (42-62%) and the reaction was required to be carried out at higher temperature (120 ºC) for longer time periods (2-4 h). However, switching to aldehyde containing substrate **6** the solvent system NMA of the aforesaid optimized reaction conditions was required to be replaced by 1,4-dioxane. A wide variety of products **8** containing different functional groups (e.g., Me, OMe, Br, Cl, F, or CO_2Me) were found to be formed easily with moderate to good yields (44-76%). The biological activity of some of these compounds is currently underway.

Future Research Plans

Preparation of the nanoencapsulated betulinic acid analogue **(2c)** and its apoptotic study of both *in-vitro* and *in-vivo* including pharmacokinetics.

Synthesis of benzo[*c*]chromenes via Pd(II)-catalyzed hetero- and carboannulations in one-pot.

Development of a convenient palladium-catalyzed method for the synthesis of naphtho[1,2-b]furans.

PUBLICATIONS

Kundu P, Mondal A and Chowdhury C. (2016) A Palladium-Catalyzed Method for the Synthesis of 2-(alpha-Styryl)-2,3-dihydroquinazolin-4-ones and 3-(alpha-Styryl)-3,4-dihydro-1,2,4-benzothiadiazine-1,1-dioxide: Access to 2-(alpha-Styryl)quinazolin-4(3H)-ones and 3-(alpha-Styryl)-1,2,4-benzothiadiazine-1,1-dioxides. *J Org Chem* **81,** 6596-660

Jash M, Das B and Chowdhury C. (2016) One-Pot Access to Benzo[a]carbazoles via Palladium(II)-Catalyzed Hetero- and Carboannulations. *J Org Chem* **81,** 10987-10999

Dr. Sharmila Chattopadhyay

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Potential role of plants to sustain human life

Participants

JRF: Priyanka Trivedi, Priyanka Boro

SRF: Saptarshi Hazra, Deepak Kumar, Mehar D. Kalim, Aparupa Bose Mazumder, Asma Sultana, Soumi Biswas

RA: Raj Gourav Ghosh, SRA (CSIR-Pool officer)

Project Assistant: Anuja Joseph

Collaborator(s)

Collaborators outside CSIR-IICB

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Tripura University, Agartala

Dr. Riddhi Datta
Dr. A.P.J. Abdul Kalam Govt. College, Kolkata

Collaborators within CSIR-IICB

Dr. Sucheta Tripathy & Dr. Saikat Chakraborty
Structural Biology & Bioinformatics Division

Background

Humans are dependent upon plants. Green plants provide most of the world's molecular oxygen. Plants produce the basic foodstuffs viz. grains, fruits and vegetables for the humankind and also served as the source of most medicines and drugs. Thus, this fascinating contribution of plants to sustain human life deserves attention.

Aims and Objectives

- Dissecting plant defense signaling mechanism.
- Metabolic engineering: to obtain improved podophyllotoxin.
- dentification of non-toxic, cost-effective neutraceuticals from plant sources.

Work Achieved

Our study demonstrated the interplay of GSH with established signaling molecules viz. ET, ABA, JA etc. to combat environmental stress. Here, to mimic nature, *Arabidopsis thalina* plants viz. Col-0, wild type; *pad 2.1* (GSH mutant), *ein* 2, (ethylene insensitive mutant), *aba*1.6 (abscisic acid mutant) and *AtECS,* the transgenic line exhibiting enhanced GSH content, were maintained under combined osmotic and cold stress for 72 hrs. Interestingly, the analyses' of stress treated plants at transcript, protein and metabolites level noted the significant alteration of the expression/content of stress responsive genes viz. *HSPs, MYB108, COR 47,* redox related genes like *GSTs, APX2, TPX2,* others like *LHY, CCA1, LHY, AP2, ERF,* etc. proteins viz. MLPs, BAG, GLP7, etc. and the secondary metabolites viz. phenylpropanoid, lignin & lignan, flavonoids, glucosinolates and terpenoids. Summarily, our results confirmed the interaction of ET and ABA with GSH by activating glutathione biosynthesis to combat environmental stress in plant system. In another investigation, our data suggested two possible mechanisms through which MeJA modulates the podophyllotoxin biosynthesis in an endangered medicinal plant viz. *Podophyllum hexandrum*, primarily by increasing the mRNA stability of ROS-responsive genes and secondly, by the up regulation of ROS non-responsive genes through the down regulation of some ROS non-responsive miRNAs. Furthermore, a non-caloric, safe, and cost effective dietary FUNCTIONAL FOOD/NEUTRACEUTICAL has been obtained from *Stevia* leaves.

Future Research Plans

Scientific validation of Indian medicinal plants to develop novel drugs with better-activity and no-toxicity.

Molecular dynamics of plant stress tolerance to combat unavoidable environmental stress.

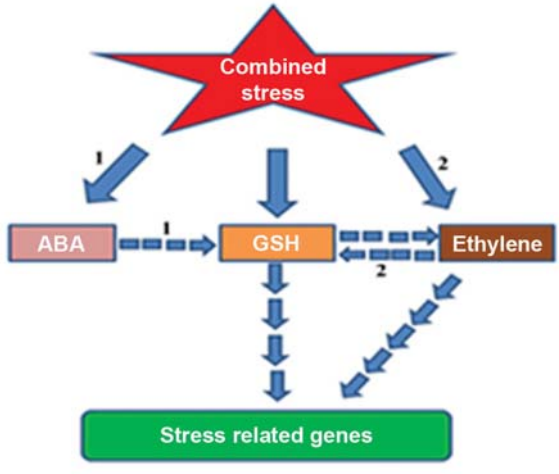


Fig. 1: Schematic presentation on interaction of ET and ABA with GSH to combat environmental stress *in planta.*

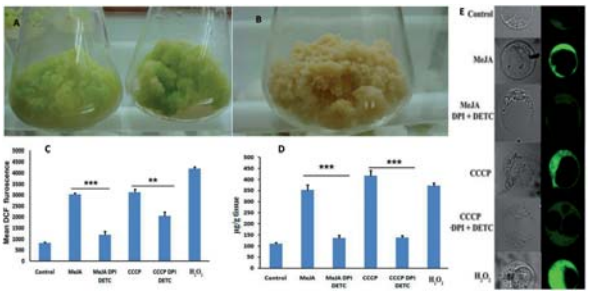


Fig. 2: A) Regenerating green calli to establish cell culture of *P. hexandrum,* B) Non-regenerating 2 month's old brown calli. C) Measurement of ROS after various treatments to the cell culture by FACS, D) Content of ptox after various treatments to the cell culture, E) Detection of ROS by confocal microscopy after staining with DCFDA of various treated cultures.

PUBLICATIONS

Hazra S., Bhattacharyya D. and Chattopadhyay S. (2017) Methyl Jasmonate Regulates Podophyllotoxin Accumulation in Podophyllum hexandrum by Altering the ROS-Responsive Podophyllotoxin Pathway Gene Expression Additionally through the Down Regulation of Few Interfering miRNAs. *Front Plant Sci* **8,** 164

Kumar D., Hazra S., Datta R. and Chattopadhyay S. (2016) Transcriptome analysis of Arabidopsis mutants suggests a crosstalk between ABA, ethylene and GSH against combined cold and osmotic stress. *Sci Rep* **6,** 36867

Bhattacharyya D., Hazra S., Banerjee A., Datta R., Kumar D., Chakrabarti S. and Chatopadhyay S. (2016) Transcriptome-wide identification and characterization of CAD isoforms specific for podophyllotoxin biosynthesis from *Podophyllum hexandrum. Plant Mol Bio* **92,**1-23

Datta R., Kumar D., Chattopadhyay S. (2016) Membrane proteome profiling of *Mentha arvensis* leaves in response to *Alternaria alternata* infection identifies crucial candidates for defense response. *Plant Signaling & Behavior,* doi: 0.1080/15592324.2016.1178423

Biswas S., Hazra S., Chattopadhyay S. (2016) Identification of conserved miRNAs and their putative target genes in *Podophyllum hexandrum* (Himalayan Mayapple) *Plant Gene* **6,** 82–89

Book Chapter

Sharmila Chattopadhyay (2016) Interplay of glutathione with SA and ET to combat environmental stress. In Drought Stress Tolerance in Plants. Springer International Publishing, Switzerland, (Eds. Dr. Md. A. Hossain, S.H. Wani, S. Bhattacharjee, D. J. Burritt and Lam-Son Phan Tran), Vol. 1, pp. 145-161.

AWARDS / HONOURS / MEMBERSHIPS

Awards / Honours

Executive committee member at National level of Proteomics Society of India

Membership

Chemical Biology Society

Student's Award

Mr. Deepak Kumar

B.M. Johri Poster Award in PTCA 2017

Dr. Riddhi Datta

INSA Medal for Young Scientists 2017

EXTRAMURAL FUNDING

"Identification of stress responsibe miRNAs in *Arabidopsis* under altered GSH conditions" 2017-2019. (SERB, India)

One project of Rs. 30,00,000/- has been approved & sanctioned by SERB, New Delhi on 30th December, 2016.

CONFERENCES:

Nunber of abstracts

India: 9

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

National symposium on "Plant Biotechnology: Current Perspectives on Medicinal and Crop Plants" & 38th Annual Meeting of Plant Tissue Culture Association (India), [PTCA- 2017] 3-5th March, 2017

INVITED TALK

Mechansitic insight into the involvement of glutathione in plant defense: a protemic approach National Institute of Plant Genome Research/ International Conference on Functional & Interaction Proteomics: Application in Food & Health; 14-17 December, 2016, New Delhi, India.

Interaction of Glutathione with ethylene to control biotrophic infection in plant CAS Phase VII, Department of Botany, University of Calcutta/International Conference on The Green Planet: past, present and future; 21-23 December, 2016, Kolkata, India.

Dr. Biswadip Banerji
biswadip@iicb.res.in

Expedient synthesis of phenanthro-imidazo-pyridine fused heteropolynuclear framework via CDC coupling: a new class of luminophores

Participants

JRF: Leena Majumder

SRF: Suvankar Bera, Satadru Chatterjee, Sunil K. Killi, Chandrasekhar K., Saswati Adhikary, Chinmay Nayon

Background

In this study we report the design and synthesis of a group of fused phenanthro-imidazo[1,2-*a*]pyridine derivatives as a new class of luminescent materials through a Pd(II) catalyzed intramolecular CDC (cross dehydrogenative coupling) reaction. This method thus unlocked a convenient & expedient way for the synthesis of a new molecular framework containing •-extended fused heteropolycycles. The heteropolycycles showed very good fluorescence properties both in solid and solution phases which were further utilized in live cell imaging. These kinds of molecules have potential to be used as therapeutic probes and also their solid state luminescence properties can be further utilized for making optoelectronic devices.

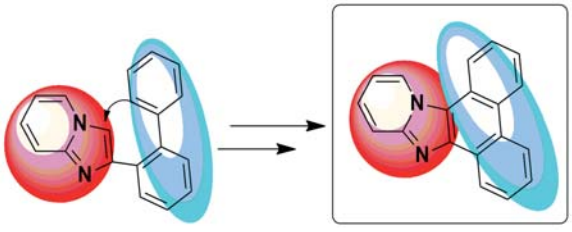


Fig. 1: Schematic Representation of the Key step involvedin the formation of heterocyclic framework

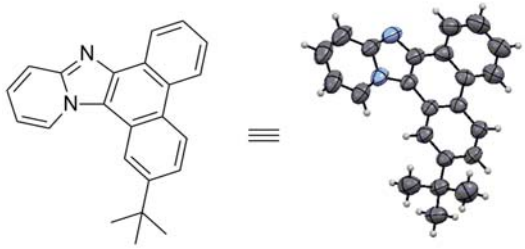
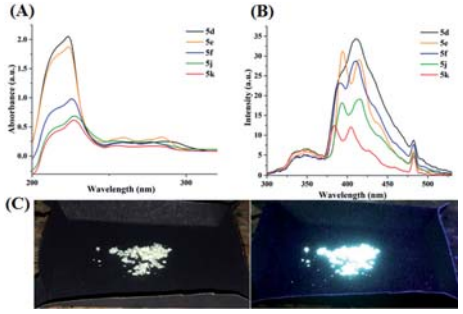


Fig. 2: Representative example with crystal structure



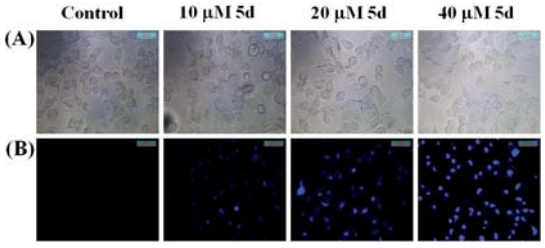


Fig. 3: Fluorescence and Cell imaging studies

PUBLICATIONS

Banerji B., Chatterjee S., Chandrasekhar K., Bera S., Majumder L., Prodhan C. and Chaudhuri K. (2017) Expedient synthesis of a phenanthro-imidazo-pyridine fused heteropolynuclear framework via CDC coupling: a new class of luminophores. *Org Biomol Chem* **15,** 4130-4134

Banerji B., Chatterjee M., Prodhan C. and Chaudhuri K. (2016) Tripeptide consisting of benzyl protected di-cysteine and phenylalanine forms spherical assembly and induces cytotoxicity in cancer cells via apoptosis. *RSC Adv* **6,** 112667-112676

Banerji B., Killi S.K., Katarkar A., Chatterjee S., Tangella Y., Prodhan C. and Chaudhuri K. (2017) Neo-tanshinlactone D-ring modified novel analogues induce apoptosis in human breast cancer cell via DNA damage. *Bioorg Med Chem* **25,** 202-212

Banerji B., Chatterjee M., Pal U. and Maiti N.C. (2016) Molecular details of acetate binding to a new diamine receptor by NMR and FT-IR Analyses. *J Phys Chem A* **120,** 2330-2341

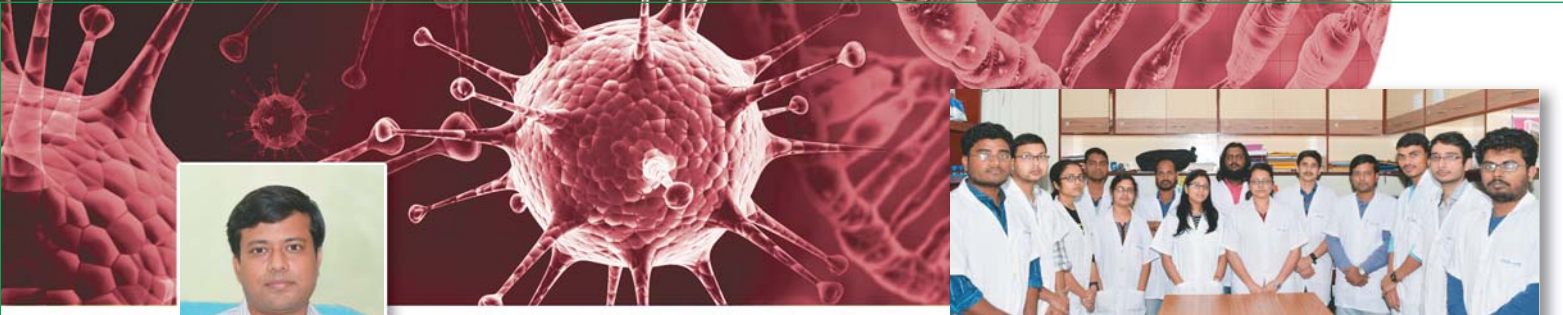
EXTRAMURAL FUNDING

"Targeting HSP-90 as cancer therapy: Design and synthesis of mahanine-derived Second-Generation lead molecules"

Start year -2016, End year-2019. (DST-SERB, India)

CONFERENCES / WORKSHOPS

Design, Synthesis and Efficacies of some New Chemical Entities (NCE), Indian Science Congress, 06 January, 2017, Tirupati, India



Dr. Surajit Ghosh
sghosh@iicb.res.in

Chemical Neuroscience: Design of peptide-based therapeutics for Alzheimer's Diseases (AD)

Participants

SRF: Prasenjit Mondal, Saswat Mohapatra, Debmalya Bhunia, Anindyasundar Adak

JRF: Krisnagshu Pradhan, Surajit Barman, Gaurav Das, Subhajit Ghosh, CSIR-Project Fellow

Collaborator(s)

Collaborators outside CSIR-IICB

Prof. Kankan Bhattacharyya, IACS Kolkata

Prof. Arindam Banerjee, IACS Kolkata

Prof. Sandeep Verma, IIT Kanpur

Prof. D. Mal, IIT Kharagpur

Prof. Yoshio Aso, Osaka University, Japan

Prof. Takeshi Sato, Osaka University, Japan

Prof. Siddhartha Roy, Bose Institute

Dr. Kaustabh Kumar Maiti, CSIR, NIIST-Trivandrum

Background

My group is currently working in the area of chemical neuroscience. We have computationally designed an interesting library consisting of ~500 peptides. From this library, we screened various peptides using computational and various *in vitro* experiments. Currently, we have found few peptides with excellent neuroprotective activities. Interestingly, in order to overcome the potential proteolytic degradation of peptides *in vivo,* we have designed peptoids based on these lead peptides. In fact, these lead peptoids are showing excellent neuroprotection. Overall, we have already few lead molecules, having high translational potential; some of the results have already been published in high visibility journals.

Aims and Objectives

- To develop peptide/peptoid-based therapeutics for Alzheimer Disease.

Work Achieved

We have developed few neuroprotective peptides and hydrogel.

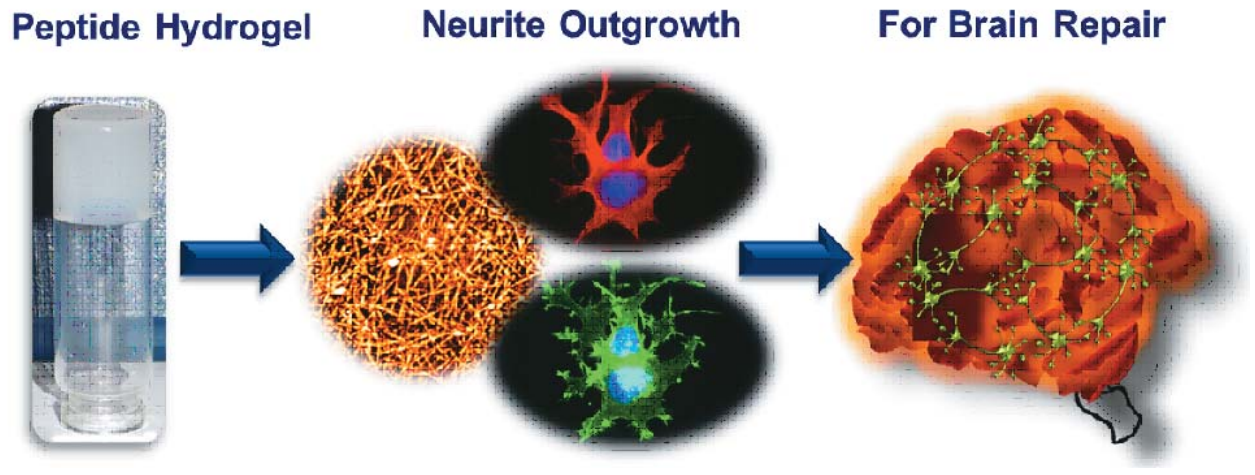


Fig. 1: Neuroprotective hydrogel for brain repair

Future Research Plans

Design of novel neuroprotecting agents for the management of Alzheimer's Disease

Design of novel anticancer molecules targeting microtubule

PUBLICATIONS

Adak A., Das G., Barman S., Mohapatra S., Bhunia D., Jana B. and Ghosh S. (2017) Biodegradable neuro-compatible peptide hydrogel promotes neurite outgrowth, shows significant neuroprotection, and delivers anti-alzheimer drug. *ACS Appl Mater Interfaces* **9,** 5067-5076

Saha A., Mohapatra S., Das G., Jana B., Ghosh S. and Bhunia D. (2017) Cancer cell specific delivery of photosystem i through integrin targeted liposome shows significant anticancer activity. *ACS Appl Mater Interfaces* **9,** 176-188

D Bhunia., A. Saha, A. Adak, G. Das, Surajit Ghosh.* A dual functional liposome specifically targets melanoma cells through integrin and ephrin receptors. **RSC Adv., 2016,** 6, 113487-113491.

1. Ghosh S., Mohapatra S., Thomas A., Bhunia D., Saha A., Das G. and Jana B. (2016) Apoferritin nanocage delivers combination of microtubule and nucleus targeting anticancer drugs. *ACS Appl Mater Interfaces* **8,** 30824-30832

2. S. Chakraborty, G. Das, Surajit Ghosh, D. Mal* Regioselective synthesis of naphthoquinone/naphthoquinol-carbohydrate hybrids by [4 + 2] anionic annulations and studies on their cytotoxicity. **Org. Biomol. Chem., 2016,** 14, 10636-10647.

Nandi S., Mondal P., Chowdhury R., Saha A., Ghosh S. and Bhattacharyya K. (2016) Amyloid beta peptides inside a reconstituted cell-like liposomal system: aggregation, FRET, fluorescence oscillations and solvation dynamics. *Phys Chem Chem Phys* **18,** 30444-30451

3. S. Mohapatra, A. Saha, P. Mondal, B. Jana, S. Ghosh, A. Biswas, Surajit Ghosh* Synergistic anticancer effect of peptide-docetaxel nano-assembly targeted to tubulin: Towards development of dual warhead containing nanomedicine. **Adv Healthcare Mater., 2016, Accepted as Cover Page.**

Bhunia D., Mohapatra S., Kurkute P., Ghosh S., Jana B., Mondal P., Saha A. and Das G. (2016) Novel tubulin-targeted cell penetrating antimitotic octapeptide. *Chem Commun (Camb)* **52,** 12657-12660

Mohapatra S., Nandi S., Chowdhury R., Das G., Ghosh S. and Bhattacharyya K. (2016) Spectral mapping of 3D multi-cellular tumor spheroids: time-resolved confocal microscopy. *Phys Chem Chem Phys* **18,** 18381-18390

C. Ghosh, D. Bhunia, S. Ghosh, B. Jana, Surajit Ghosh,* K Bhattacharyya.* Fluorescence Probing of Fluctuating Microtubule using a Covalent Fluorescent Probe: Effect of Taxol. **Chemistry SELECT, 2016,** 1, 1841-1847.

Jana B., Mohapatra S., Mondal P., Barman S., Pradhan K., Saha A. and Ghosh S. (2016) alpha-Cyclodextrin interacts close to vinblastine site of tubulin and delivers curcumin preferentially to the tubulin surface of cancer cell. *ACS Appl Mater Interfaces* **8,** 13793-13803

Adak A., Mohapatra S., Mondal P., Jana B. and Ghosh S. (2016) Design of a novel microtubule targeted peptide vesicle for delivering different anticancer drugs. *Chem Commun (Camb)* **52,** 7549-7552

PATENTS FILED / SEALED

Surajit Ghosh

Patent Title: A hexapeptide interacts with tubulin/microtubule and exhibits significant neuroprotection against Aβ toxicity thereof.

Country: US

Patent No. 15/062773.

Date filed: 7th March, 2015

Co-inventors and their Institutes: Atanu Biswas, Suraiya Saleem, Batakrishna Jana, Saswat Mohapatra, Prasenjit Mondal, Anindyasundar Adak, Subhajit Ghosh, Abhijit Saha, Debmalya Bhunia, Subhash Chandra Biswas from CSIR IICB.

Patent filed by CSIR-IICB

Surajit Ghosh

Patent Title: "A LIPOSOMAL COMPOSITION OF PHOTO SYSTEM-I FOR TREATMENT OF CANCER"

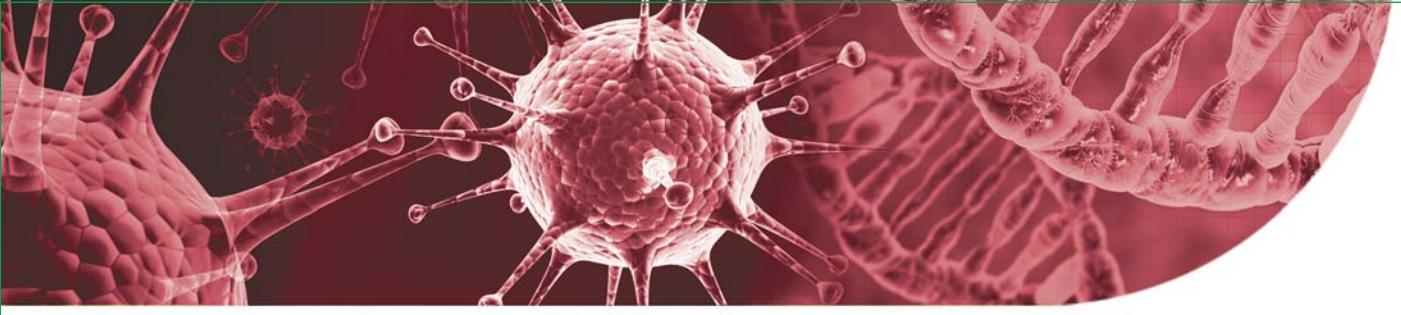
Country: India

Patent No. 0058NF2016

Date filed: 7th March, 2016

Co-inventors and their Institutes: Abhijit Saha, Subhajit Ghosh, Saswat Mohapatra, Batakrishna Jana, Debmalya Bhunia from CSIR IICB.

Patent filed by CSIR-IICB



AWARDS / HONOURS / MEMBERSHIPS

Dr. Surajit Ghosh

Associate Editor of Royal Society of Chemistry (RSC Advances), August 2015-Till Date

Fellow of Royal Society of Chemistry (FRSC), August 2016

Young Scientist Award by Indian Peptide Society, February 2017

EXTRAMURAL FUNDING

Surajit Ghosh

Development of anti-alzheimer peptide from taxol binding pocket of β-tubulin.

2016 - 2018. (DST, India)

CONFERENCES / WORKSHOPS

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

INVITED TALKS

Dr. Surajit Ghosh

1. "Microtubule targeted chemically functionalized graphene oxide micro/nano particle" International symposium NANOBIOCON at Science City, Kolkata on 3-4 October, 2016

2. "Understanding Dynamics of Biological Systems using Fluorescence Spectroscopy and Microscopy?" TEQIP II sponsored workshop on "Fundamentals and Applications in Biomolecular Spectroscopy "at NIT Patna during 25th-26th October, 2016.

3. "Cancer Cell Specific Delivery of Docetaxel: Towards Development of Nanomedicine" Indo-German meeting in November 10-13, 2016 at Khajuraho, India.

4. "Cancer Cell Specific Delivery of Docetaxel: Towards Development of Nanomedicine?"The 20th ISIR International Symposium on Molecular Technology Frontiers towards IoT World, 12-13th December, 2016, in Osaka, Japan

5. "Purine Based Metal Carbene Complexes for Inhibition of Tubulin Polymerization" 5th Symposium on the Advances in Bioinorganic Chemistry, January 7-11, 2017 in Kolkata, India

6. "Microtubule targeted neuroprotective peptide" IIT Patna on 1st February, 2017

7. "Development of Cancer Cell Specific Docetaxel Nanoformulation" TEQIP II sponsored Short Term Course on "Strengthening of Institute-Industry Interaction" at NIT Patna 2nd February, 2017

8. "Microtubule targeted neuroprotective peptide" NDD 2017: International Conference on "Neurodegenerative Disorders: Current and Future Perspective", February 10-12, 2017 in Kolkata, India

9. "Development of Cancer Cell Specific Docetaxel Nanoformulation" A Summer School in Chemical Sciences in the Rajabazar Science College Campus on 6th February, 2017

10. "Microtubule targeted neuroprotective peptide" NDD 2017: International Conference on "Neurodegenerative Disorders: Current and Future Perspective", February 10-12, 2017 in Kolkata, India

11. "Microtubule targeted neuroprotective peptide" Indian Peptide Symposium on February 23, 2017, at Homi Bhaba Centre, Mumbai, India (Young Scientist Award Talk)

Dr. Indrajit Das
indrajit@iicb.res.in

Tandem chemoselective sulfur migration in ã-ketothioesters: direct approach to substituted butenolides

Participants

JRF: Sandip Naskar, Rajib Maity

SRF: Kanchan Mal

Collaborator(s)

Collaborator outside CSIR-IICB

Dr. Sabyashachi Mishra
Assistant Professor Department of Chemistry, IIT Kharagpur

Background

Sulfanyl group migration is an important chemical transformation and is extensively studied in the synthesis of modified carbohydrates, heterocycles as well as acyclic compounds. Several elegant approaches have been developed for the 1,2-migration of the thio group in the past few years. Among the numerous methods developed, the most common route reported so far proceeds mainly through a key thiiranium intermediate, which undergoes rearrangement, elimination, or substitution reactions. Unlike 1,2-migration of the thio group, there has been limited success in 1,4-sulfanyl group migration. The most common route reported so far proceeds through the thiolanium intermediate. To the best of our knowledge, there are no reports of tandem chemoselective 1,2-/1,4-migration of the thio group from a ketothioesters. On the other hand, substituted butenolides with one or more quaternary centres are privileged structural motifs occurring in a plethora of biologically active natural products and pharmaceutically important molecules. However, chemical synthesis of such molecules is very challenging and remains a dynamic area of research for the past few decades. Several elegant approaches have been developed for their synthesis, which are mostly limited to the direct functionalization of pre-existing substituted butenolide scaffolds. Therefore, general approaches for the construction of these essential scaffolds, under metal/ligand-free conditions, are still highly desirable.

Aims and Objectives

1,2- and 1,4-sulfanyl group migration Elusive Thiyl Radical Migration in a Visible Light Induced Chemoselective Rearrangement of γ-Keto Acrylate Thioesters:Synthesis of Substituted Butenolides α-Keto Thioesters as Building Blocks for Accessing diverse biologically important heterocycles

Work Achieved

α-Keto thioesters, with two electrophilic carbon centres, have been found to react differently with β-keto esters and isocyanoacetates. They undergo base induced Knoevenagel-type condensationon the keto carbonyl group with β-keto esters, followed by intramolecular cyclization and water addition leads to highly substituted γ-hydroxybutenolides.On the other hand,substituted oxazole derivatives have been obtained using isocyanoacetates via nucleophilic displacement on the thioester carbonyl followed by intramolecula cyclization

Further functionalization of the ã-hydroxybutenolides is also demonstrated via a $BF_3.OEt_2$-mediatedcation-driven nucleophilic addition of terminalalkynes to access multiply substituted butenolides.

Future Research Plans

α-Keto Thioesters as Building Blocks for Accessing diverse biologically important heterocycles

PUBLICATIONS

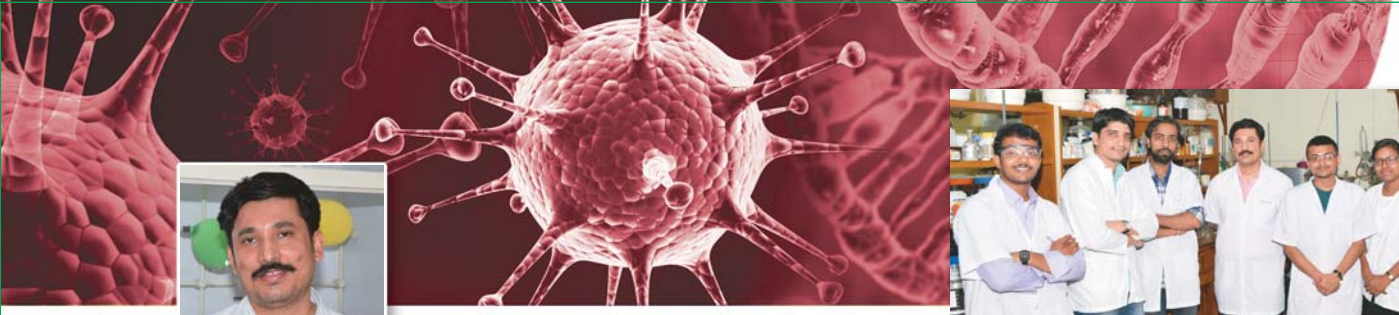
Naskar K and Das I. (2017) Elusive thiyl radical migration in a visible light induced chemoselective rearrangement of ã-Keto acrylate thioesters: synthesis of substituted butenolides. *Adv Synth Catal* **359**, 875 – 885

Zimmermann L, Das I, Desire J, Sautrey G, Barros RSV, El Khoury M, Mingeot-Leclercq MP and Decout JL. (2016) New broad-spectrum antibacterial amphiphilic aminoglycosides active against resistant bacteria: from neamine derivatives to smaller neosamine analogues. *J Med Chem* **59,** 9350-9369

Mal K, Naskar S, Sen SK, Natarajan R and Das I. (2016) Tandem chemoselective 1,2-/1,4-migration of the thio group in keto thioesters: an efficient approach to substituted butenolides *Adv Synth Catal* **358,** 3212 – 3230

EXTRAMURAL FUNDING

α-Ketothioesters: An Indispensable Building Blocks for Accessing Diverse Heterocycles via Sulfanyl Anions or Thiyl Radical Migration. File No: EMR/2016/001720, 2017 - 2019. (SERB, India)



Dr. Sanjay Dutta
sanjaydutta@iicb.res.in

Development of novel small molecules targeting nucleic acids (DNA and RNA) and their fluorescent conjuagtes which can be utilized as small molecule probe, diagonistics and therapeutics (antiviral and antibiotics)

Participants:

JRF: Chandra Sova Mandi, Ritesh Pal, Jeet Chakravarty

SRF: Tridib Mahata, Ajay Kanungo,Subhadeep Palit, Dipendu Patra

Collaborator(s)

Collaborator outside CSIR-IICB

Prof. Gautam Basu
Department of Biophysics, Bose Institute,
Kolkata 700054

Background

Our laboratory at CSIR-Indian Institute of Chemical Biology is involved in the development of RNA "biased" ligands which will be targeted towards subdomain IIa of Hepatitis C Virus-Internal Ribosome Entry Site RNA (HCV IRES RNA). It comprise mainly of small molecules designed on the basis of crystal structure of IRES (Structure based drug design). The screening of the small molecules is done by the FRET assay or an assay involving a fluorescent probe in the IRES domain IIa. "Hit" compounds are tested by replicon assay. **(DBT funded Project).**

Aims and Objectives

Targeting nucleic acids (DNA & RNA) by small molecules based on natural products, carbohydrates and heterocycles.

- Targeting viral RNA (Hepatitis C Virus) and bacterial RNA, development of RNA targeted therapy.
- Exploring the mechanisms of actions of natural compounds targeting DNA, which will ultimately be utilized for targeting particular diseases and discovery of drug like molecules.
- Targeting cellular receptors for drug delivery to liver.

Work Achieved

We have successfully designed HCV IRES inhibitors by the FRET assay and Dual luciferase reporter assay, which are effective in reducing the viral cap independent translation in low micromolar range. We are currently optimizing the synthesis to get the IRES inhibitors in nanomolar binding affinities with IRES *(unpublished data)*. Some of these IRES inhibitors are also effective in binding DNA and also can be used as anticancer agents.

We have previously reported a 6-nitroquinoxaline-2,3-diamine scaffold with a mandatory benzyl substituent and a *N,N*-dimethyl amine tail intercalated DNA, inducing conformational change only after a certain ligand/DNA ratio and in a co-operative fashion. We show by Atomic force microscopy at single molecule level, the formation of a plectonemically oversupercoiled structure of plasmid pBR322 DNA by the nitroquinoxaline DNA intercalator. Our biophysical studies with AT rich and GC rich plasmids, poly(AT) and poly(GC) oligonucleotide shows that the benzyl group of the nitroquinoxaline small molecule has a very important role in the structural change of DNA and binds differently in GC and AT sequences. This is a follow up of ***Angew. Chem. Int. Ed.* 2016,** 55, 7733-7736, doi:10.1002/anie.201511881, *unpublished data)*

Future Research Plans

Elucidation of the unusual DNA structure formed. Development of effective noncovalent DNA binders and anticancer agents. Study of the DNA damage mechanisms of these quinoxaline compounds. Cellular delivery of DNA damaging agents. Development of RNA binding small molecules with fluorescent properties.

PUBLICATIONS

Sanhueza C.A., Baksh M.M., Thuma B., Roy M.D., Dutta S., Preville C., Chrunyk B.A., Beaumont K., Dullea R., Ammirati M., Liu S., Gebhard D., Finley J.E., Salatto C.T., King-Ahmad A., Stock I., Atkinson K., Reidich B., Lin W., Kumar R., Tu M., Menhaji-Klotz E., Price D.A., Liras S., Finn M.G. and Mascitti V. (2017) Efficient Liver Targeting by Polyvalent Display of a Compact Ligand for the Asialoglycoprotein Receptor. *J Am Chem Soc* **139,** 3528-3536

Mahata T., Kanungo A., Ganguly S., Modugula E.K., Choudhury S., Pal S.K., Basu G. and Dutta S. (2016) The Benzyl Moiety in a Quinoxaline-Based Scaffold Acts as a DNA Intercalation Switch. *Angew Chem Int Ed Engl* **55,** 7733-773

EXTRAMURAL FUNDING

Discovery of RNA binding ligands-targeting HEPATITIS C VIRUS RNA. July 2015 – July 2018. (DBT, India)

CONFERENCES / WORKSHOPS

Number of abstracts

India: 2

AWARDS / HONOURS / MEMBERSHIPS

Student's Award

Tridib Mahata

Received Commendable Poster Award at Annual Symposium of the Indian Biophysical Society (IBS) 2017, held at IISER Mohali

Dr. Ranjan Jana

rjana@iicb.res.in

A combined late stage C-H functionalization and affinity-based protein profiling strategy for the identification of highly selective kinase inhibitors in breast cancer cell lines

Participants

JRF: Gurupada Bairy

SRF: Asik Hossian, Manash Kumar Manna, Samir Kumar Bhunia, Arghya Polley

RA: Dr. Ashok Behera

N-PDF: Dr. Suvankar Das

Collaborator(s)

Collaborators within CSIR-IICB

Dr. Mrinal K. Ghosh
Cancer Biology & Inflamatory Disorder Division

Dr. Subhas C. Biswas
Cell Biology & Physiology Division

Background

The establishment of drug resistance following treatment with chemotherapeutics is strongly associated with poor clinical outcome in patients, and drugs that target chemoresistant tumors have the potential to increase patient survival. In an effort to identify biological pathways of chemoresistant breast cancers that can be targeted therapeutically, a small molecule screen utilizing metastatic patient-derived breast cancer cells is extremely essential.

Aims and Objectives

- Synthesis of basic pharmacophores and their late-stage diversification via site-selective C-H activations
- Initial phenotypic screen of this library of compounds against MCF-7 primary breast cancer cell line and the corresponding MCF-10A normal cell line in 3D cell culture for hit optimization
- Affinity-based protein profiling for target identification, validation and hit to lead optimization through structure modifications

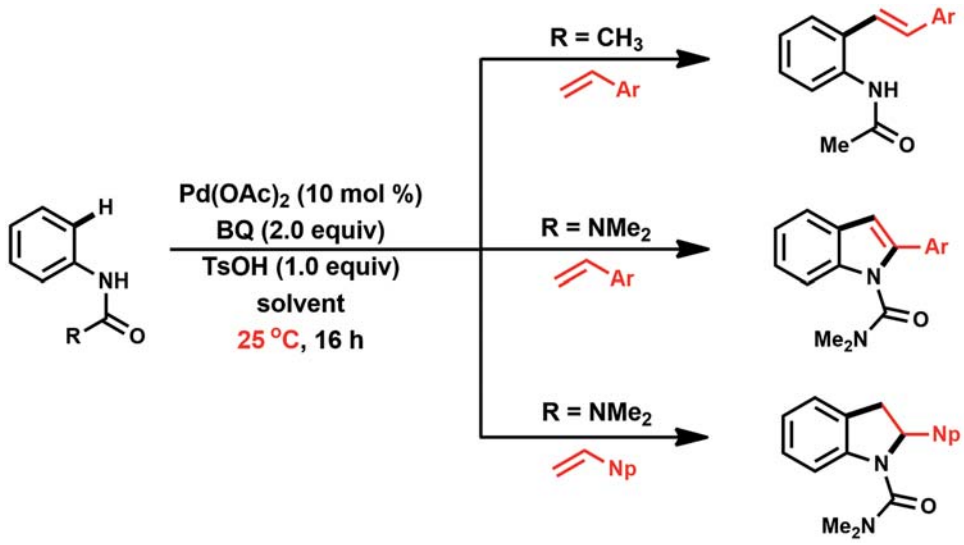
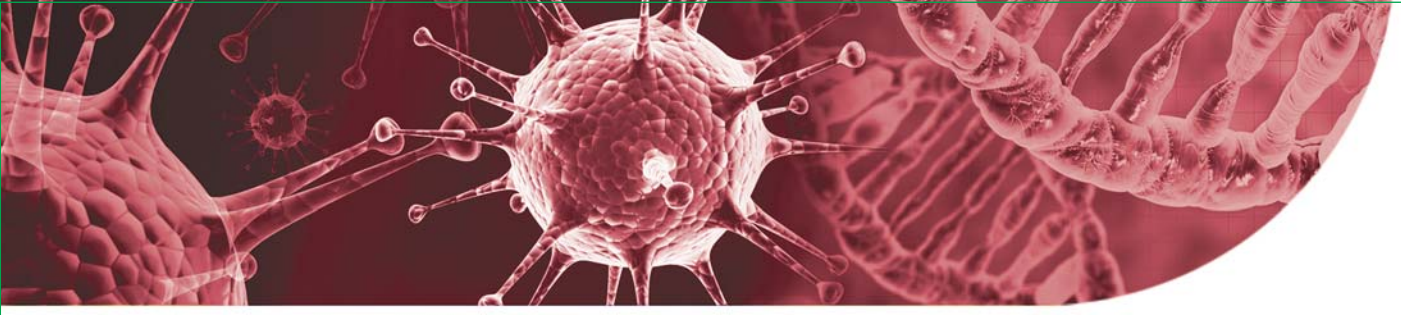


Fig. 1: Molecular Diversity through Cascade C-H Activation



Work Achieved

We have initiated and optimized the synthesis of basic scaffolds through C-H activation. We have accomplished a palladium-catalyzed synthesis of 2-arylindoles, and indolines from readily available and inexpensive aryl ureas and vinyl arenes merging C-H activation and alkene difunctionalization at room temperature. The reaction initiates with a urea-directed electrophilic ortho palladation, alkene insertion, and β-hydride elimination sequences to provide the Fujiwara-Moritani arylation product. Subsequently, aza-Wacker cyclization, and β-hydride elimination provide the 2-arylindoles in high yields. Intercepting the common σ-alkyl-Pd intermediate, corresponding indolines are also achieved. The 2-arylindole moiety has been extended to the dibenzofused carbazole system through multiple C-H activations. The molecular affinity probe for pull down experiment has also been synthesized.

Future Research Plans

Evaluation of these molecules against breast cancer and other cell lines are undergoing. Affinity-based protein profiling (ABPP) for the identification of highly selective inhibitor is the future goal of this project.

PUBLICATIONS

Singh B.K. and Jana R. (2016) Ligand-Enabled, Copper-Promoted Regio- and Chemoselective Hydroxylation of Arenes, Aryl Halides, and Aryl Methyl Ethers. *J Org Chem* **81,** 831-841

Hossian A., Bhunia S.K. and Jana R. (2016) Substrate-Dependent Mechanistic Divergence in Decarboxylative Heck Reaction at Room Temperature. *J. Org. Chem* **81,** 2521-2533

Singh B.K.S., Polley A., Jana R. (2016) Copper(II)-Mediated Intermolecular C(sp2)–H Amination of Benzamides with Electron-Rich Anilines. *J. Org. Chem* **81,** 4295–4303

Hossian A., Jana R. (2016) Carboxyl radical-assisted 1,5-aryl migration through Smiles rearrangement. *Org. Biomol. Chem* **14,** 9768–9779

EXTRAMURAL FUNDING

Ranjan Jana

A Combined Late Stage C-H Functionalization and Affinity-Based Protein Profiling Strategy for the Identification of Highly Selective Kinase Inhibitors in Breast Cancer Cell Lines 2014-2018, DST, SERB, Govt of India, Project # SR/S2/RJN-97/2012

Molecular Diversity through Cascade C-H Activations
2015-2018, DST, SERB, Govt. of India, Project # EMR/2014/00469

CONFERENCES / WORKSHOPS

Dr. Ranjan Jana

Delivered invited lecture on “Green Chemistry and Engineering from Societal Perspectives.”

Delivered invited lecture on “Molecular Diversity through Cascade C-H Activations” i) ASG Biochem; ii) NIPER, Kolkata in front of Sanofi India.

Delivered invited lecture on “Molecular Diversity through Cascade C-H Activations” at BITS, Pilani Goa Campus.

Dr. Arindam Talukdar

atalukdar@iicb.res.in

Probing endosomal toll-like receptor 9 biology using novel small molecule antagonists

Participants

JRF: Dipayan Sarkar

SRF: Ayan Mukherjee, Barnali Paul, Swarnali Roy, Biswajit Kundu,

RA: Namrata Roy

Project Assistant: Sourav Pal

Collaborator(s)

Collaborator within CSIR-IICB

Dr. Dipyaman Ganguly
Cancer Biology & Inflammatory Disorders Division

Background

Targeted Structure based design and synthesis of inhibitors for various diseases.

Aims and Objectives

The main aim of the lab is development of affordable drugs for potential treatment for human diseases. The goal is to rationally design selective inhibitors for the nucleic acid-recognizing Toll-like receptors (TLRs) for devising novel therapeutic strategies in relevant clinical contexts in different autoimmune diseases.

To perform structure based design and synthesis of small-molecule regulators of epigenetics modifying enzymes such as histone methyltransferases (HMT) for development of epigenetic-based drugs for the treatment of a number of diseases.

Work Achieved

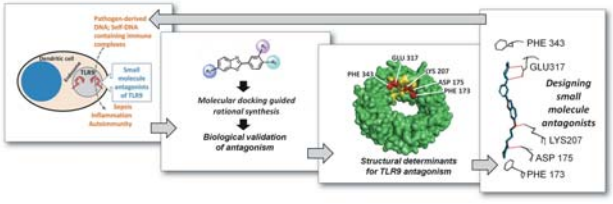
We have successful developed potent and selective Toll-like receptor 9 antagonists and filled two patents to protect the IP. We have also published one paper to establish our understanding in the autoimmune diseases.

Future Research Plans

Preclinical development of rationally designed inhibitors for the nucleic acid-recognizing Toll-like receptors (TLRs) for which two patent has been filed.

Establish industrial partner to take forward our IP protected knowledge to commercialization.

To seek ways to establish a long term scientific collaboration on mutual strength between India and Australia in neglected disease drug discovery.



PUBLICATIONS

Roy S., Mukherjee A., Paul B., Rahaman O., Maithri G., Ramya B., Pal S., Ganguly D. and Talukdar A. (2017) Design and development of benzoxazole derivatives with toll-like receptor 9 antagonism. *Eur J Med Chem* **134**, 334-347

PATENTS FILED / SEALED

Arindam Talukdar

Patent Title:

BLOCKING TOLL-LIKE RECEPTOR 9 SIGNALING WITH SMALL MOLECULE ANTAGONIST

Country: PCT

Patent No: PCT/IN2017/050103

Grant date: 21/03/2016

Co-inventors: Dipyaman Ganguly, Barnali Paul, Ayan Mukherjee, Shaunak Roy, Swarnali Roy, Amrit Raj Ghosh, Roopkatha Bhattacharya, Oindrilla Rahaman

Patent filed by: CSIR-IICB

EXTRAMURAL FUNDING

Grant Title: Probing endosomal toll-like receptor 9 biology using novel small molecule antagonists. 2016-2018 (DST-SERB, INDIA).

Name of the Principal Investigator

Dr. Arindam Talukdar.

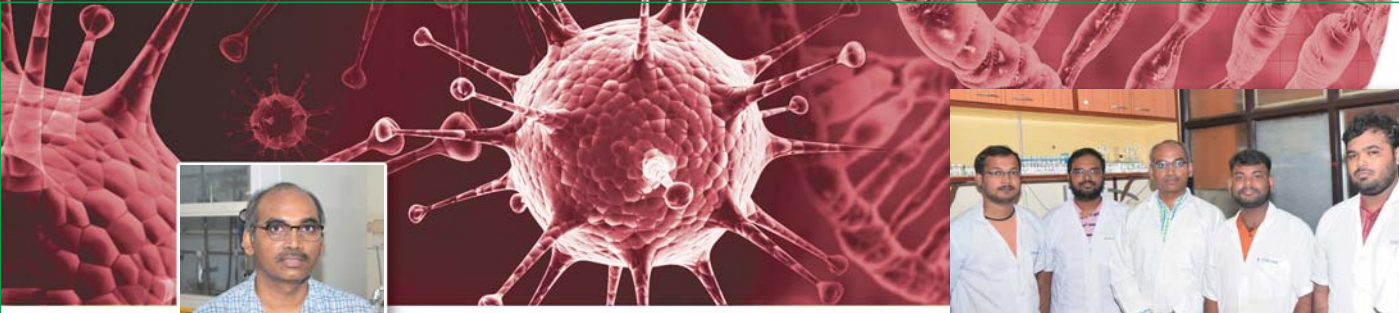
Co- Principal Investigator: Dr. Dipyaman Ganguly. Email: dipyaman@iicb.res.in

Grant Title: Exploring Therapeutic Efficacy of Novel Toll like Receptor 9 Antagonist in Type II Diabetes. 2017-2019 (DST-SERB, INDIA). (DST-SERB)

Name of the Principal Investigator

Dr. Dipyaman Ganguly.

Co- Principal Investigator: Dr. Arindam Talukdar. Email: atalukdar@iicb.res.in



Dr. R. Natarajan
rnatraj@iicb.res.in

Synthetic receptors and ligands

Participants

JRF: Raju Biswas,

SRF: Shovan Kumar Sen, Jayanta Samanta, Krishanu Samanta

Collaborator(s)

Collaborator outside CSIR-IICB

Dr. Swapan Majumdar
Tripura University, India

Collaborators within CSIR-IICB

Dr. Krishnanda Chattopadhyay
Structural Biology Division

Dr. Subhas C. Biswas
Cell Biology & Physiology Division

Dr. Indrajit Das, Dr. Surajit Ghosh
Organic & Medicinal Chemistry Division

Background

Molecular materials capable of encapsulating large organic molecules, either drugs or toxins, are in demand to deliver the former in a targeted manner or to remove the later from the environment, respectively.Therapeutic and diagnostic agents against Alzheimer disease are in urgent demand for the elederly population of our country.

Aims and Objectives

- Development of novel synthetic scaffolds for the inclusion of biologically relevant molecules through specific intermolecular interactions
- Development of therapeutic and diagnostic agents for Alzheimer's disease

Work Achieved

We have developed a novel cage-like organic receptor through a high-yielding synthethic method. The cage can efficiently bind carcinogenic polycyclic aromatic hydrocarbons with great affinity. The system has an excellent potential to be developed as a carcinogen trap.

We have identified a class of lead molecules as therapeutic agents for Alzheimer's disease and further work is going on.

Future Research Plans

Development of novel, efficient and targetted drug delivery systems

Development of early stage diagnostic systems for Alzheimers

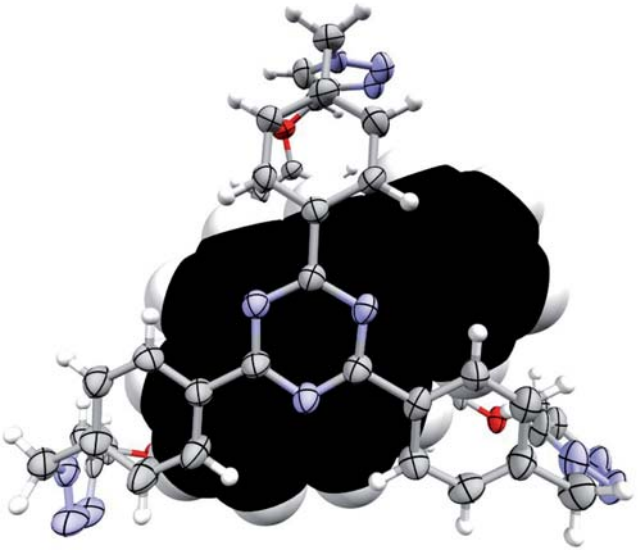


Fig.1: Xray Structure of the organic cage inticrated within polycylic arromatic hydro carbon guest

PUBLICATIONS

Samanta J. and Natarajan R. (2016) cofacial organic click cage to intercalate polycyclic aromatic hydrocarbons. *Org. Lett.***18,** 3394-3397

Mal K., Naskar S., Sen S.K., Natarajan R. and Das I. (2016) Tandem chemoselective 1,2-/1,4-migration of the thio group in keto thioesters: an efficient approach to substituted butenolides. *Adv. Synth. Catal.* **20,** 3212-3230

AWARDS / HONOURS / MEMBERSHIPS

Students

Jayanta Samanta

Awards: Best poster award at 44th National Seminar on Crystallography; Pune, India July 2016

EXTRAMURAL FUNDING

R. Natarajan

Metal-Organic Frameworks (MOFs) from Bile Acid Derivatives as Carriers for Drug Delivery. 2013 - 2017. (SERB, India)

Ramanujam Fellowship. 2013-2018. (SERB, India)

INVITED TALK

R. Natarajan

Cofacial organic click cage as an efficient receptor for polycyclic aromatichydrocarbons;Invited talk; IISER-Pune / 44th National Seminar on Crystallography; Pune, India, July 2016

Dr. Indu Bhusan Deb

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Development of new catalytic system using transition metals (Pd, Fe, Ni, Ru & Rh) to perform affordable, efficient, and innovative as well as industry friendly C–H/C–X bond cleavage for the synthesis of functionalized potential bioactive small molecules

Participants

JRF: Arindam Das, Writabrata Sarkar, Sumit Das,

SRF: Aniket Mishra

Project Assistant: Tripta Kumari

Collaborator(s)

Collaborators within CSIR-IICB

Dr. Subhas C. Biswas
Cell Biology & Physiology Division

Dr. Uday Bandyopadhyay & Dr. Subhajit Biswas
Infectious Diseases and Immunology Division

Background

The ubiquitousness of indole, azaindole and pyrrole skeletons in various natural products, pharmaceuticals and synthetic materials make them immensely valuable heterocycles. Hence development of new and efficient methods for their synthesis and derivatization assumes high significance. Our group is actively involved in designing methodology to synthesized functionalized bioactive heterocycles employing transition metal (Pd, Fe, Ni, Ru & Rh) catalyzed C–H/C–X bond activation concept.

Aims and Objectives

- Development of transition metal catalyzed cost effective affordable and industry friendly C-H activation methodology for azaindole functionalization.
- Development of methodology for Indolyl/pyrrolyl-3-phosphonates.
- Synthesis of small molecules againt AD and PD.

Work Achieved

We have developed a convenient and cost effective synthetic route for the synthesis of substituted indolyl-3-phosphonates and pyrrolyl-3-phosphonates in good to excellent yields via oxidative cyclization (dual C–H activation) of the corresponding imino/enamino phosphonates depicted in **Fig. 1**(published in Advanced Synthesis and Catalysis).

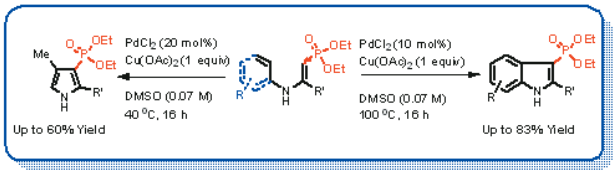


Fig. 1: Indole/pyrole synthesis using dual C–H activation methodolgy

Employing C-H bond activation technology we have developed an efficient, highly regioselective and scalable ruthenium-catalyzed ortho aryl C–H mono cyanation of *N*-aryl-7-azaindoles to form *N*-(2-cyanoaryl)-7-azaindoles through N-directed ortho C–H activation using easily accessible and non hardus cyanating reagent depicted in **Fig. 2** (published in Journal of Organic Chemistry).

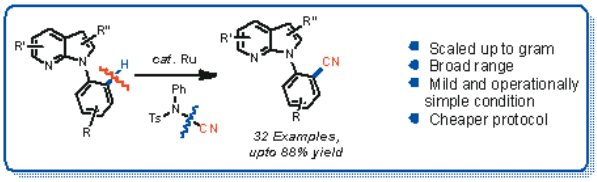


Fig. 2: Cyanation reaction employing ruthenium catalyzed C–H activation concept

Employing C-H bond activation we have developed C-H thionylation and C-H selenylation of *N*-aryl-7-azaindoles (manuscript submitted).

Future Research Plans

Development of transition metal catalyzed industry friendly and affordable C-H bond activation methodology for the synthesis of biologically important heterocycles. Photophysical study and bioactivity study of newly synthesized molecules will be pursued.

PUBLICATIONS

Mishra A. and Deb I. (2016). Palladium-Catalyzed Oxidative Cyclization for mthe synthesis of Indolyl/Pyrrolyl 3-Phosphonates. *Adv Syn & Catalysis* **358,** 2267–2272

Mishra A., Vats T.K. and Deb I. (2016) Ruthenium-Catalyzed Direct and Selective C-H Cyanation of N-(Hetero)aryl-7-azaindoles. *J Org Chem* **81,** 6525-653

AWARDS / HONOURS / MEMBERSHIPS

Awards / Honours

Bristol Mayer Squibb Research Fellowship-USA

Memberships

Life member of Chemical Biology society

EXTRAMURAL FUNDING

Bristol Mayer Squibb research Grant. 2015-2017. (BMS-USA)

DST 1st Track research fund. 2014-2017

CONFERENCES / WORKSHOPS

Number of abstracts India: 1

Molecular Genetics Division

Dr. Suvendra Nath Bhattacharyya (Head) and Dr. Debabrata Biswas

This department has mandates to identify the role of pathogens in modulating small RNAs in the host; to find whether telomere length or senescence factors are responsible for the carcinogenic effects of arsenic; to determine the molecular basis of gene delivery to mitochondria, and to understand the eukaryotic transcriptional regulatory mechanisms and their role in human diseases.

Previous work led to the development of a novel carrier-based protocol for mitochondrial RNA therapy; in the following years we propose to explore the mechanism of uptake and intracellular targeting of the carrier complex and RNA to mitochondria in animal model. Emphasis will be placed on determination of the function of microRNAs in parasitic disease (leishmaniasis) and also in cancer.

One objective of this department is poised to indentify the mechanisms that regulate activity of different miRNAs in ammalian cancer and immune cells and to relate these to disease onset and progression. Mechanistic understanding and regulation transcription process at molecular level is also under investigation. Using a combination of basic and applied approaches we will study the molecular basis of genetic disease and its therapy.

Dr. Suvendra Nath Bhattacharyya

suvendra@iicb.res.in

Regulation of miRNA activity in mammalian immune and cancer cells

Participants

JRF: Avijit Goswami, Dipayan De, Satarupa Ganguly, Diptankar Banerjee, Susanta Chatterjee, Saikat Banerjee

SRF: Bahnisikha Barman, Kamalika Mukherjee, Yogaditya Chakrabarty, Mainak Bose, Bartik Ghoshal

RA: Dr. Sudarshana Basu, Dr. Arnab Das

Collaborator(s)

Collaborators outside CSIR-IICB

Dr. Edouard Bertrand,
IGMM, Montpellier France

Dr. Saumitra Das, MCBL
IISC, Bengaluru

Collaborator within CSIR-IICB

Dr. Saikat Chakraborty
Structural Biology & Bioinformatics Division

Background

Regulation of the tiny regulatory RNA in mammalian cell

Research at RNA Biology Research Laboratory is concentrated on identification of novel gene regulatory mechanisms operating in mammalian cells that are primarily executed by small regulatory RNA- the microRNA. We explore the mechanisms that regulate microRNAs levels and activities in mammalian immune, neuronal and cancer cells. The major goal of our research is to identify the machineries that either by regulating the intra and extracellular transport of microRNAs or by modifying microRNA interacting proteins affects the microRNA function in mammalian cells. Contributions of subcelluar structures and organelles in compartmentalization of miRNAs biogenesis, function and turnover in mammalian cells is also explored under this research aim. Alteration in miRNA-machinery upon exposure of mammalian cells to pathogens and its implications in the disease process is the other major thrust area of our research.

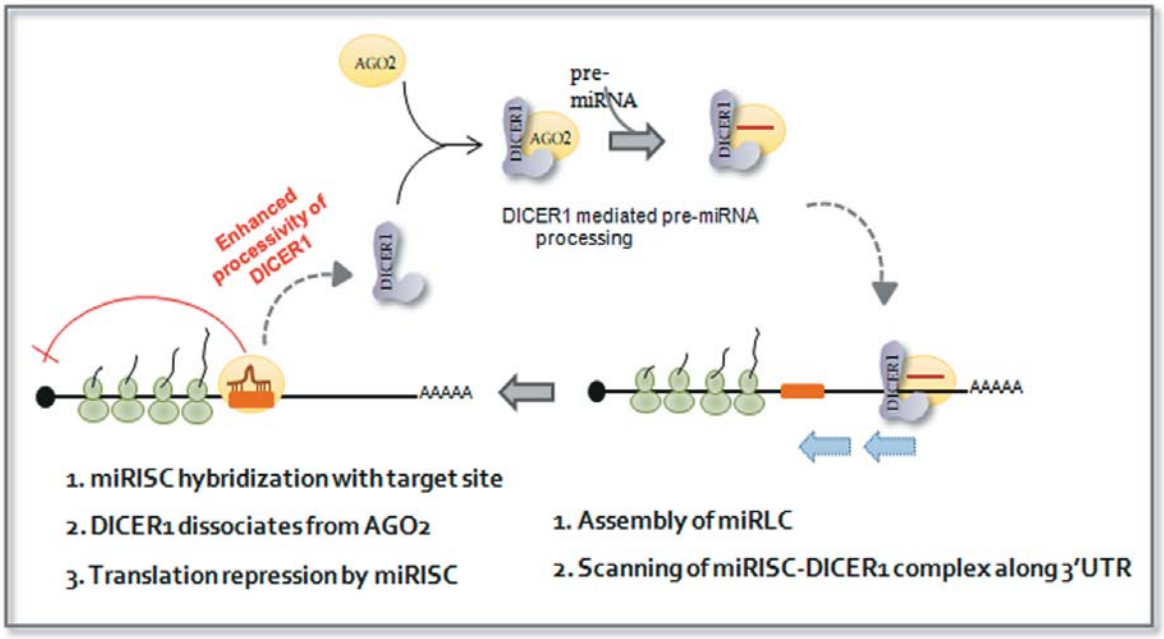
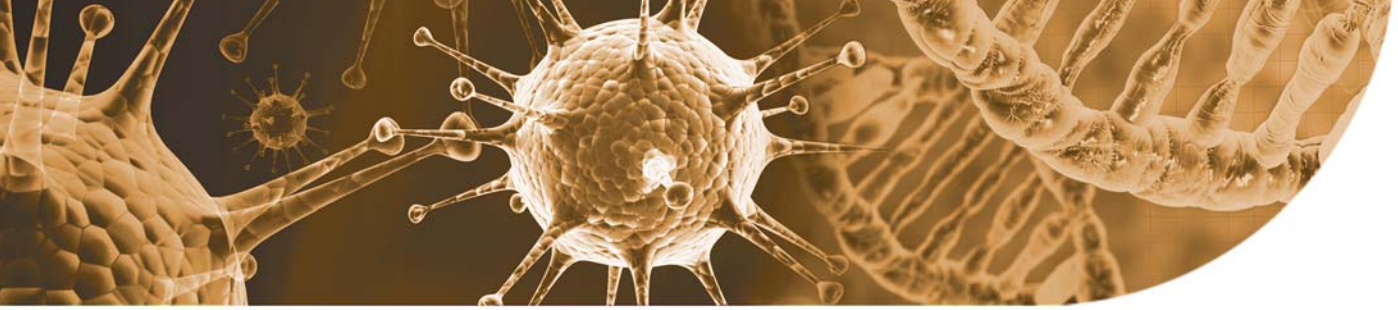


Fig. 1: Target Dependnent biogensis of ongnate miRNAs (From Nature Communications, Bose and Bhattacharyya 2016)



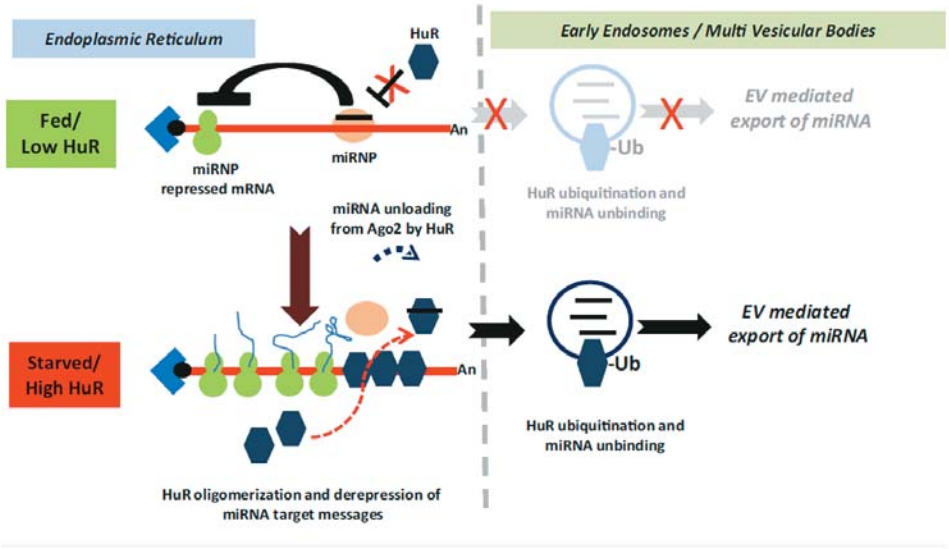


Fig. 2: HuR driven export of cellular miRNAs via Extracellular Vesicles (EVs) (From Mukherjee et al. 2016, EMBO Reports

Aims and Objectives

There are four major aspects that we explore:

- Compartmentalization of miRNA-mediated gene repression machineries in mammalian cells
- Regulation of miRNA transfer between mammalian cells
- Modulation of miRNA binding of Ago proteins by intrinsic and extrinsic factors in neuronal and immune cells
- Pathogen mediated alteration in miRNA-machinery in Leishmania invaded macrophage and neighboring non-macrophage cells

Work Achieved

We have delinated novel mechanism of selective export of miRNAs from ammaian cells in response to stress as a primary way of balancing miRNA activity in mammalian cells

We have aso identified a new mechanism that govern miRA biogenesis in human cells in response to external cues.

Future Research Plans

We plan to investigate the role of subcellular structures in controlling miRNA activity n mammalian cells

PUBLICATIONS

Bose M., Barman B., Goswami A. and Bhattacharyya S.N. (2017) Spatiotemporal uncoupling of microRNA-mediated translational repression and target RNA degradation controls microRNP recycling in mammalian cells. *Mol Cell Biol* **37**

Mukherjee K., Ghoshal B., Ghosh S., Chakrabarty Y., Shwetha S., Das S. and Bhattacharyya S.N. (2016) Reversible HuR-microRNA binding controls extracellular export of miR-122 and augments stress response. *EMBO Rep* **17,** 1184-1203.

Bose M. and Bhattacharyya S.N. (2016) Target-dependent biogenesis of cognate microRNAs in human cells. *Nat Commun* **7,** 12200

Patranabis S. and Bhattacharyya S.N. (2016) Phosphorylation of Ago2 and subsequent inactivation of let-7a RNP-Specific MicroRNAs control differentiation of mammalian sympathetic neurons. *Mol Cell Biol* **36,** 1260-1271

Book Chapters / Invited Reviews

Bogdan Mateescu, [a], * Emma J. K. Kowal, [b], * Bas W. M. van Balkom, [c] Sabine Bartel, [d] Suvendra N. Bhattacharyya, [e]Edit I. Buzás, [f] Amy H. Buck, [g] Paolade Candia, [h] Franklin W. N. Chow, [g] Saumya Das, [i] Tom A. P. Driedonks, [j] Lola Fernández-Messina, [k] Franziska Haderk, [l], [m] Andrew F. Hill, [n] Jennifer C. Jones, [o] Kendall R. Van Keuren-Jensen, [p]Charles P. Lai, [q] Cecilia Lässer, [r], [s] Italia di Liegro, [t] Taral R. Lunavat, [r], [s] Magdalena J. Lorenowicz, [u] Sybren L. N. Maas, [v] Imre Mäger, [w], [x] Maria Mittelbrunn, [y] Stefan Momma, [z] Kamalika Mukherjee, [e] Muhammed Nawaz, [aa] D. Michiel Pegtel, [ab] Michael W. Pfaffl, [ac] Raymond M. Schiffelers, [ad] Hidetoshi Tahara, [ae] Clotilde Théry, [af] Juan Pablo Tosar, [ag] Marca H. M. Wauben, [j] Kenneth W. Witwer, [ah] and Esther N. M. Nolte-'t Hoen [j] , (2017). Obstacles and opportunities in the functional analysis of extracellular vesicle RNA - an ISEV position paper. *J Extracell Vesicles.* Mar 7;6(1):1286095.

AWARDS / HONOURS / MEMBERSHIPS

Awards / Honours

Shanti Swarup Bhatnagar Prize in Biological Sciences 2016 by CSIR, Govt. of India

National Bioscience Award for Career Development by Dept. of Biotechnology, Govt. of India

CDRI Award for Excellence in Drug Research by CSIR-CDRI Lucknow

Membership

Selected Fellow of the Indian Academy of Science (IAS), Bengaluru

Student's Award

Kamalika Mukherjee

International RNA Society Travel Fellowship

EMBL Advanced Training Centre Corporate Partnership Programme Fellowship

Yogaditya Chakrabarty

EMBO Travel Fellowship

Mainak Bose

Dept of Science and Technology International Travel Fellowship

Bartika Ghoshal

Raman-Chapak Fellowship under Indo-French Program

Dipayan De

Awarded the Best Oral presentation at the International Conference on Neurodegenerative disorders: current and future perspective

EXTRAMURAL FUNDING

Compartmentalization of microRNA-Dependent Post-transcriptional Processes in Mammalian Cells: Role of Sub-cellular Structures and Organelles (High Risk High Reward Project) 2017-2020. (DST, Govt. of India, India)

Role of inter- and subcellular miRNA trafficking in controlling lipid metabolism in mammalian liver cells (Swarnajayanti Fellowship Project) 2016-2021. (DST, Govt. of India, India)

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

Organize the India Belgium Symposium at CSIR-IICB on 6-8th February, 2017

INVITED TALKS

Delivered a talk in the Indo-Brazil Symposium on the Biochemistry of Kinetoplastid Parasites held at CSIR-Indian Institute of Chemical Biology (CSIR-IICB), Kolkata on September 19 and 20, 2016.

Delivered a talk in INSPIRE Science CAMP, DST, Govt. of India during 25th October to 29th October, 2016 at National Institute Science & Technology Palur Hills, Berhampur, Orissa.

Give a Colloquium Lecture at CSIR-Indian Institute of Chemical Biology on 3rd November, 2017.

Gave a lecture and interact with JBNSTS Scholars at Jagadis Bose National Science Talent Search, Rajdanga Main Road,Kolkata on 5th November, 2016.

Give an invited talk in the Transcription Assembly meeting in Bose Institute on 9th November, 2017

Delivered a Colloquium talk at Bose Institute, Kolkata on November 15th, 2017.

Gave an invited talk in the 85th annual meeting of SBC (I) on "Innovations in Biological Research on Health and Disease" in CFTRI-Mysuru on 22nd November, 2016

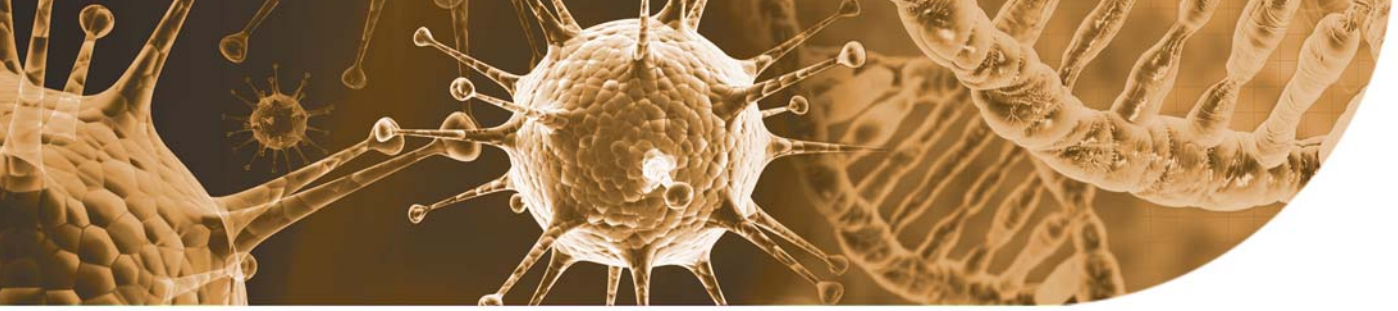
Give an invited talk in IISc Bangaore at MCBL on 25th Novemver, 2016

Attend and deliver a lecture in the Vijyoshi Camp at IISER Kolkata on 5th December, 2016

Gave an invited talk in the Winter Research Seminar Day 2016 at IISER Mohalion December 8th, 2016

Gave an invited lecture in the "3rd International Meet on Advanced Studies in Cell Signaling Network (CeSiN 2016)" which will be held on 18-20th December, 2016 at CSIR-Indian Institute of Chemical Biology, Kolkata.

Attend and deliver a talk in INSPIRE camp in KIIT, Bhubaneswar, Orrisa on 12th January, 2017-04-25



Gave a talk in INSPIRE camp in AMITY University Gwalior, MP on 18th January, 2017-04-25

Delivered an invited talk in 3rd International Conference on Perspectives of Cell Signaling and Molecular Medicine will be held during 8-10 January, 2017, at Bose Institute, Kolkata, India

Delivered a talk in in the Indo-Belgian Workshop to be held during 06-08 February, 2017 at Floatel, Kolkata

Delivered an invited talk in International Seminar on Neurodegenrative Diseases: Current and Future Perspective during February 10-12, 2017 organized by University of Calcutta, Institute of Neurosciences, Kolkata (IN-K) and Institute of Neurosciences, Newcastle University Upon Type, UK at Grand Hotel, Kolkata.

Delived an invited talk in the the 38th Annual Meeting of the Plant Tissue Culture Association (India) on the theme, 'Plant Biotechnology: Current Perspectives on Medicinal and Crop Plants' during 3rd-5th March, 2017.

Gave an invited talk Symposium on Gene-Environment interaction in Disease, Development and Evolution from 05th to 06th March, 2017at Cytogenetics Section at Deprtment of Zoology, BHU, Varanasi

Chaired a session in the conference on "INFORMATION TRANSFER ACROSS SCALES: MOLECULES TO BEHAVIOR". The conference held at Centre for Research in Nanosciences and Nanotechnology on 10th and 11 of March, 2017

Delivered an invited talk in the the UGC-SAP symposium on "Advances in Disease Biology and Disease Management" that is being organized by the Department of Biochemistry, University of Delhi South Campus on the 18th of March, 2017.

Delivered a Colloquium lecture at CDFD, Hyderabad on 23rd March, 2017

Delivered an invited talk symposium on " Current advances in molecular and host pathogen interactions " 28-30th March, 2017 at NIT, Durgapur

International Meetings

Presented a Poster in the EMBL-EMBO Meetings on the complex life of mRNA held in EMBL, Heidelberg Germany on 5-8th October, 2016

Give an invited talk in Curie institute, Paris France on complex life of miRNAs on 3rd October, 2016

Give an invited talk in University of Regensburg, in Germany on Regulation of miRNA activity on 4th October, 2016.

Give an invited talk in CSHL Asia meeting on Extracellular Vesicles, held in Souzou, China in December 12-16th.

Dr. Debabrata Biswas

dbiswas@iicb.res.in

Mechanistic understanding of eukaryotic transcriptional regulation and its implication in human diseases

Participants

JRF: Sujoy Pa

SRF: Mahesh Barad, Subham Basu, Kaushik Ghosh, Nidhi Kumari, Dipika Yadav, Dheerendra Pratap Mall, Md. Abul Hassan

Project Assistant: Arijit Nandy,

Collaborator(s)

Collaborator outside CSIR-IICB

Dr. Benu Brata Das
Indian Association for Cultivation of Science, Kolkata

Collaborator within CSIR-IICB

Dr. Surajit Ghosh
Organic & Medicinal Chemistry Division

Background

As part of our on-going work, we have observed novel interactions between the MLL fusion partners with DBC1 and FKBP5 proteins. Both the human DBC1and FKBP5 proteins have been described to be involved in multiple disease pathogenesis including leukemia. However, mechanisms of these disease pathogenesis by these two factors are not known. Using varoius *in vitro* biochemical and *in vivo* cell biological studies, we would like to explore the role of these two proteins in MLL fusion partner-mediated transcriptional regulation. We would like to further explore the importance of these mechanistic understanding in MLL fusion-mediated leukemogenesis.

Aims and Objectives

- Identifying the stable DBC1 protein complex and associated components.
- Further understanding of role of some of these components in SEC-mediated transcriptional regulation
- Detailed understanding of role of FKBP5 in SEC complex-mediated transcriptional regulation.

Work Achieved:

Through our work, we have uncovered a novel role of human DBC1 in regulation of stability of ELL protein for its physiological functions. Mechanistically we have shown that ELL protein is acetylated by p300 acetyl transferase both *in vitro* and *in vivo* and this acetylation stabilizes ELL protein in vivo. Furthermore, we have shown that, HADC3 deacetylase destabilizes ELL protein through its deacetylase function. An overplap for the same lysine residues for the acetylation and ubiquitylation determines the stabilization and destabilization of ELL protein by p300 and Ubiquitylatiom machinery. DBC1 stabilizes ELL protein through protection of ELL acetylation and thereby is involved in transcriptional regulation through stabilization of the key *bona fide* elongation factor.

Future Research Plans

Further understanding of role of DBC1 in regulation of activity of other elongation factors.

Mechanistic understanding of role of FKBP5 in transcriptional regulation

EXTRAMURAL FUNDING

Functional Characterization of human DBC1 complex in transcriptional regulation and leukemogenesis. Dec 2014 - Nov 2019 Wellcome-Trust DBT India Alliance, a collaborative effort by Dept. of Biotechnology, Govt. of India and Wellcome-Trust, London, United Kingdo

Elucidation of functional role of human FKBP5 in eukaryotic transcriptional regulation, Apr 2017 - Mar 2020. Dept. of Science and Technology, Govt. of India

CONFERENCES / WORKSHOPS

Representative member of CSIR-IICB, I was actively involved in organzing national level "Transcription Assembly Meeting 2016" at Bose Institute, Kolkata

INVITED TALKS

Mechanistic insight into role of DBC1 in regulating ELL function through coordinated action of p300, HDAC3 and ubiquitylation machinery. Transcription AssemblyBose Institute, 2016, Kolkata, India.

Multivalent role of human TFIID complex in regulation of transition from initiation to elongation. 6th Asian Chromatin Meeting. CCMB, Hyderabad, India.

Structural Biology & Bioinformatics Division

Dr. Debasish Bhattacharyya (Head), Dr. Subrata Adak, Dr. Soumen Datta, Dr. Krishnananda Chattopadhyay, Dr. Jayati Sengupta, Dr. Saikat Chakrabarti, Dr. Nakul C. Maiti, Dr. Sujoy Mukherjee, Dr. Sucheta Tripathy, Dr. Siddhartha Roy and Dr. G. Senthil Kumar

With a view to understand cellular function and dysfunction in human health and disease, researchers at the Structural Biology & Bioinformatics Division attempt to probe into the structural and mechanistic features of various proteins, macromolecular complexes and cellular pathways, using integrative, trans-disciplinary approaches. Basic as well as translational research are being carried out on protein structures, functions, protein-protein interactions, protein-nucleic acid interactions, applying state-of-the-art technologies like X-ray crystallography, Nuclear Magnetic Resonance (NMR), Cryo-EM, single molecule fluorescence measurements and Fluorescence Correlation Spectroscopy, Raman spectroscopy, mass spectrometry, Nano-separation technology etc. Bioinformatic studies involving big data analysis, genome/proteome data mining, molecular dynamic simulations, molecular docking and pathway analysis are also being pursued. Special emphasis has been given on macromolecules and small molecules of therapeutic interest against diseases like leishmaniasis, tuberculosis, malaria, multiple amyloid-related neurodegenerative diseases, systemic diseases like cancer and diabetes and microbial infections. Specific objectives of these studies include (i) identification of non-native conformers and oligomers in neurodegenerative diseases, (ii) delineation of the key processes/factors involved in protein misfolding, aggregation and amyloid formation (iii) elucidation of cellular defenses against aberrant protein folding, (iv) development of novel strategies for amelioration of protein misfolding disorders, (v) Studying sequence aspects of intrinsically disordered proteins and their plausible implications in diseases (vi) studying ribosomal RNA-assisted folding of denatured proteins in yeast and leishmania (vii) investigating oxidative stress responses in Leishmania (viii) harvesting cyanobacterial & fungal genomes in search of commercially important enzymes, (ix) metagenomic and pan-genomic analysis of human microbiome components in an attempt to explore their plausible roles in human health and diseases (x) studying parasitic (e.g.,malaria) and systemic disease (e.g., cancer) interactomes for identification of novel drug targets, (xi) development of novel software tools for NGS data mining, pathway analysis and other big data analysis and (xii) design and development of biological knowledgebase of clinical/societal relevance.

Dr. Subrata Adak

adaks@iicb.res.in

Leishmania major expresses acidic PAS domain containing phosphoglycerate kinase

Participants

SRF: Jayasree Roy, Ayan Adhikari, Aditi Mukherjee

JRF: Saroj Biswas, Priya Das, Sumit Das

Technical officer: Khudiram Naskar

Background

Leishmania infection results into severe, life-threatening disease and is a growing public health concern in many countries including India. Resistance to existing drugs has created demand for new drug targets. Our laboratory has had a long-standing interest in *Leishmania* biology for identifying new genes, specific for the parasite that can be potential target sites for drug development. One of the new parasite specific proteins is PAS domain containing phosphoglycerate kinase. It has been already established that Per-Arnt-Sim (PAS) domains carry out diverse functions within sensory proteins by signal transfer or supporting protein/protein interaction as well as by directly sensing environmental stimuli.

Aims and Objectives

- We are interested to find-out the role of this protein in virulence on infection with macrophages as well as inoculation into BALB/c mice.
- To find out the exact molecular mechanism and signaling pathways involved in PAS domain containing phosphoglycerate kinase deficient *Leishmania* infected macrophage.

Work Achieved

We report the first PAS domain containing phosphoglycerate kinase in unicellular eukaryotic organisms, *Leishmania*. The PAS domain of this new protein exhibits structural properties similar to PAS domain of HIF 1α and this protein is present in the lysosome, where acidic pH directly stimulates phosphoglycerate kinase activity. Gene knock-out and overexpression studies suggest that pH dependent ATP generation from ADP plays a fundamental role in cell survival through the regulation of autophagosome. In addition, the knock-out cells display a marked decrease in virulence on infection with host macrophages as well as inoculation into BALB/c mice. Our work begins to clarify how acidic pH-dependent ATP generation by phosphoglycerate kinase is likely to function in cellular adaptability in *Leishmania*.

Future Research Plans

We are also interested to reveal the exact signaling pathways involved in PAS domain containing phosphoglycerate kinase deficient *Leishmania* infected macrophage. Deleting of PAS domain containing phosphoglycerate kinase causes dramatic drop in parasites infectivity. Thus, targeting PAS domain containing phosphoglycerate kinase gene could be a promising field for developing

AWARDS / HONOURS / MEMBERSHIPS

Awards / Honours

Fellow of West Bengal Academy of Science and Technology for the year 2016

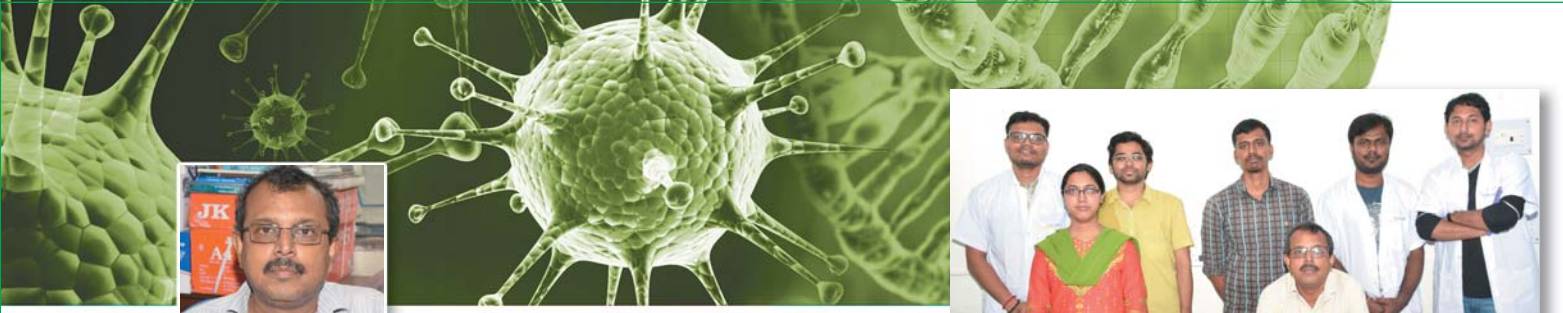
EXTRAMURAL FUNDING

Expression, intracellular localization and functional characterization of PAS domain containing phosphoglycerate kinase in Leishmania. 2017-2000 (DST, India)

CONFERENCES / WORKSHOPS

Number of abstracts

India: 2



Dr. Saumen Datta
saumen_datta@iicb.res.in

Structural and functional investigation of proteins of Type III Secretion System (T3SS) and Pantothenate or Vitamin B5 synthesis pathway

Participants

SRF: Pranab Halder, Basavraj Khanppavar, Abhishek Mandal

JRF: Rajeev Kumar, Arkaprabha Choudhury, Gourab Basu Choudhury, Atanu Pramanik

Project Assistant: Chittran Roy

Background

The Gram negative bacterium Pseudomonas aeruginosa is a predominant cause of nosocomial infections in hospitalized patients. Acute infections like sepsis, ventilator-associated pneumonia and infections among the burn-patients are caused by P. aeruginosa. In spite of the availability of various broad and narrow spectrum antibiotics, the 2014 Antimicrobial Resistance report of theWorld Health Organization mentions that within a few years of administration the bacterium is getting resistant to highly effective antibiotics. Antibiotic resistance thus developed by unsuccessful treatments has been posing as a major problem for the treatment of P. aeruginosa affected individuals. Structural, biophysical and biochemical analysis of proteins involved in the maintenance of housekeeping pathways in such organisms

would help us to delineate the mechanism, explore the correlation between different pathways and develop new chemotherapeutic agents.

Aims and Objectives

One of the examples of such housekeeping pathways is the pantothenate and CoA biosynthesis pathwaywhich is controlled by two rate limiting enzymes named pantothenate kinase and phosphopantetheine adenylyltransferase (PPAT). Based on the three major criteria introduced by Osterman and Begley for developing a potent chemotherapeutic agent exploration of these metabolite biosynthesis pathways is of considerable interest from the mechanistic point of view.

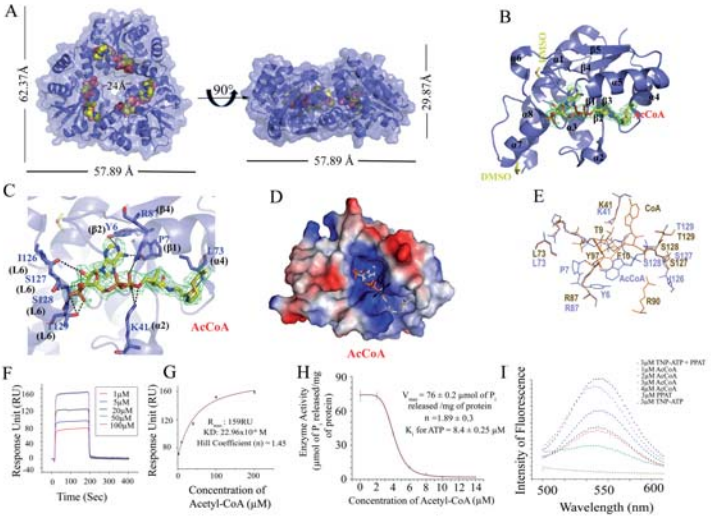
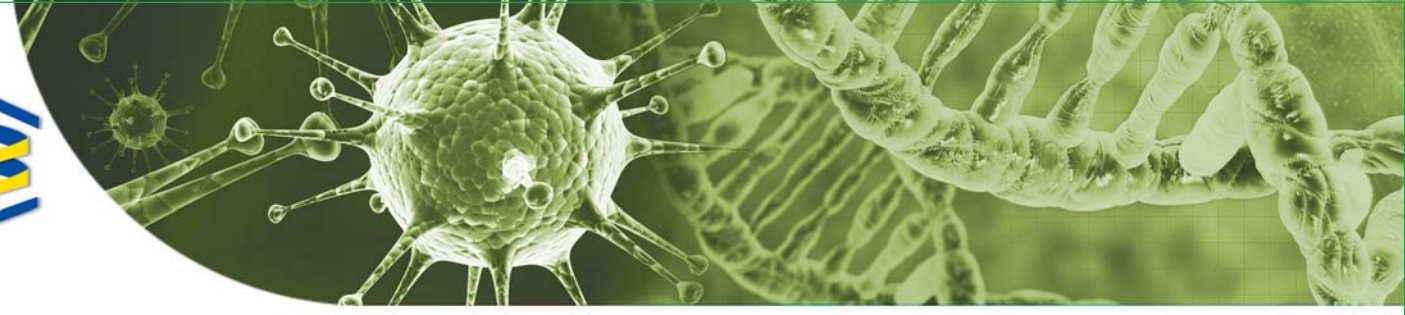


Fig. 1: Kinetic and structural analyses of PPAT from Pseudomonas aeruginosa with AcCoA, a newly found allosteric inhibitor: (A) Trimeric structure of PPAT with AcCoA. The protomers within the asymmetric unit are represented in cartoon (slate) with the AcCoA (ligand) shown in spheres (yellow carbon; red oxygen, orange phosphate; nitrogen blue). The solvent accessible surface area is shown in slate. A 90° rotation indicates the assembly of trimers (space group C2221). (B) A single protomer with AcCoA comprising of 8α helices and 5β strands. The density of AcCoA is shown in green mesh. (C) Residues interacting with AcCoA are shown in sticks (slate). The nitrogen is colored in blue and oxygens are shown in red. The residues corresponding to the helices, strands and loops are indicated within brackets. (D) Surface representation of the PPAT–AcCoA complex. (E) Superposed residues interacting with CoA and AcCoA in P. aeruginosa (orange and slates respectively). (F) SPR sensogram of PPAT with AcCoA as a substrate. Concentrations used for the study were 1, 5, 20, 50, and 100 μM. (G) The concentration of AcCoA was plotted against the response unit. (H) The sigmoidal enzymatic kinetic curve of PPAT exhibiting inhibition by AcCoA. AcCoA concentration (μM) was plotted against enzyme activity. (I) Fluorescence spectrum of PPAT binding with TNP-ATP. AcCoA concentrations used were 1 μM, 2 μM, 3 μM and 4 μM for a protein concentration (PPAT-His) of 3 μM along with 3μM of TNP-ATP.



Work Achieved

Attempts were made to understand the mechanistic details of the transition of P. aeruginosa-PPAT from substrate binding mode to allosteric mode. Prior investigation shows that the transition takes place via an intermediary ternary complex formation. To further delineate the facts at atomic level, CoaD was co-crystallized with four different ligands and the acquired structural data were corroborated with results derived by other biophysical and biochemical methods. We have established Acetyl CoA (AcCoA) as a new allosteric inhibitor of PPAT. Further characterization of PPAT was done using various biochemical, biophysical and structural methods.

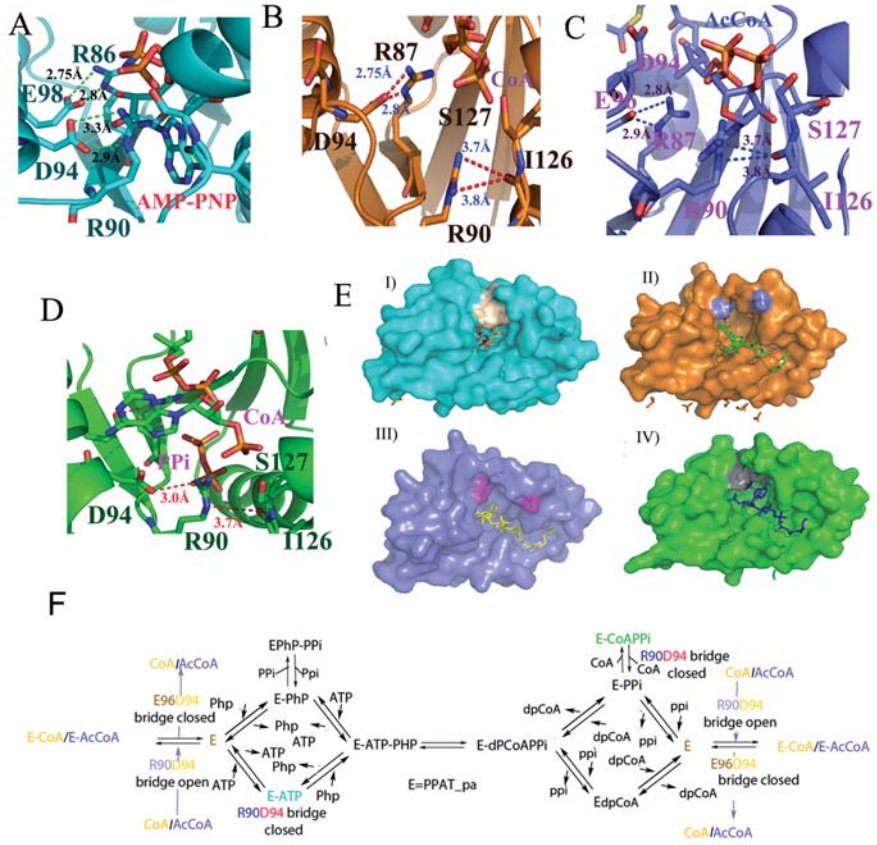


Fig. 2: Transition of PPAT-His through various states mediated by arginine switching: Structural changes in PPAT-His on encountering different ligands; (A) PPAT-His with AMP-PNP where R90 is bonded to D94. (B) PPAT-His with CoA where R90 is bonded to I126 and D94 is free. (C) PPAT-His with AcCoA where R90 is bonded to I126 and D94 is free. (D) PPAT-His with CoA and pyrophosphate where R90 is bonded to D94 and I126. (E) Surface representation of PPAT-His with (I) AMP-PNP (cyan) where R90 and D94 forma bridge (wheat), (II) CoA (orange) where R90 and D94 are apart (slate), (III) AcCoA (slate) where R90 and D94 are apart (magenta), and (IV) CoA and pyrophosphate (green) where R90 and D94 form a bridge (gray). (E) Schematic representation of transition of PPAT-His during allosteric to catalytic mode via ternary complex formations. The inhibitors CoA and AcCoA are colored in dark yellow and violet respectively. The transition in the free enzyme to CoA and Acetyl CoA is colored by dark brown, the substrate mimicking state with TNP-ATP colored cyan and intermediate ternary complex of CoA with PPi (pyro phosphate) colored green.

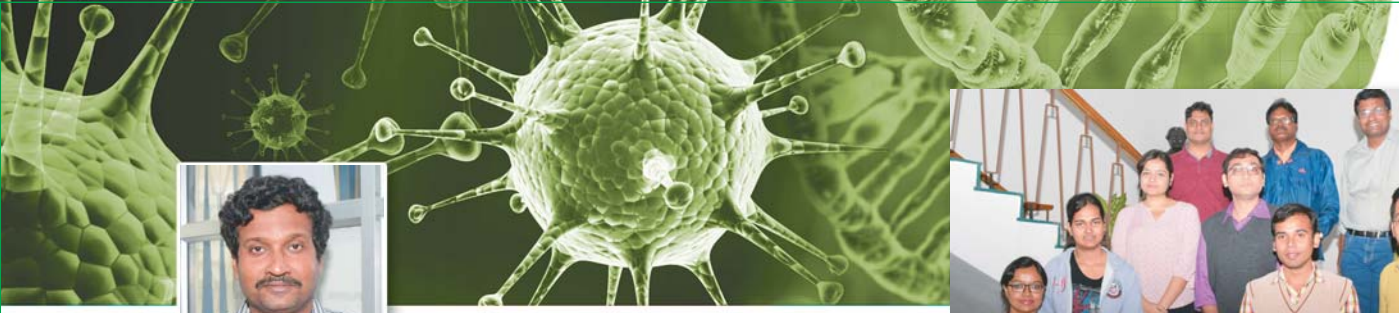
PUBLICATIONS

Mondal A. and Datta S. (2017) Quantum mechanical electronic structure calculation reveals orientation dependence of hydrogen bond energy in proteins. *Proteins* **85,** 1046-1055

Chatterjee R., Mondal A., Basu A. and Datta S. (2016) Transition of phosphopantetheine adenylyltransferase from catalytic to allosteric state is characterized by ternary complex formation in *Pseudomonas aeruginosa*. *Biochim Biophys Acta* **1864,** 773-786

EXTRAMURAL FUNDING

Structural and Functional Elucidation of T3SS Effectors with or without their Cognate Chaperone/Target Proteins from Pathogenic Bacteria, 2015 – 2018, DST



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Protein folding, dynamics and aggregation....one molecule at a time

Participants

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Collaborator(s)

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Background

Protein aggregation has been implicated in several neurodegenerative diseases. In addition, protein aggregation may create serious complications in Biologics formulations. One of the major bottlenecks of protein aggregation research arises from the heterogeneity of protein folding/aggregation landscape. In addition, the aggregation kinetics often goes through a lag phase and the present detection techniques seem to be inadequate to understand the events, which occurs in the lag phase of aggregation. We have been studying protein conformation, dynamics and aggregation using different biophysical methods including Fluorescence correlation spectroscopy (FCS). FCS is an important technique to measure the diffusional and conformational fluctuations of fluorescently labeled molecules at single molecular resolution. These fluctuations could be analyzed by using suitable correlation functions yielding useful information regarding the shape and/or conformational dynamics of a protein.

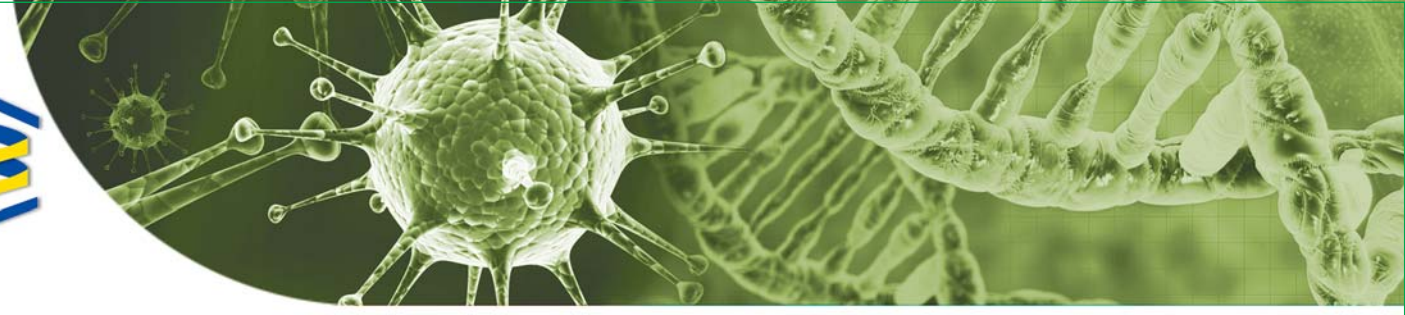
Aims and Objectives

- To detect, characterize and investigate in details the early folding pathways of proteins involved in different neurodegenerative diseases
- To Study early stages of aggregation of intrinsically disordered proteins (IDPs) *in vitro* and inside live cells using fluorescence correlation spectroscopy (FCS).

Work Achieved

We have been studying protein conformation, dynamics and aggregation using different biophysical Previously, we have shown by a number of orthogonal techniques including analytical ultracentrifugation, dynamic light scattering and native gel electrophoresis that aggregation of bovine serum albumin can be minimized by using high concentration of arginine. Urea induced unfolding transition of cytochrome c has been studied by FCS. Measurements of microsecond dynamics using appropriately labeled cytochrome c indicates formation of an intermediate state, which has been found to be absent in the presence of arginine. The hydrodynamic radii of the protein in its native, unfolded, and intermediate states have been determined using FCS. Using FCS and other biophysical methods we have shown that the secondary function of a protein (many proteins carry out additional secondary function in addition to their primary functions) depends on the subtle change in the surface charge distributions.

We have now developed ways to detect oligomeric molecules, which populate in the early events of alpha synuclein aggregation pathways. The aggregation of alpha synuclein has been implicated strongly in the pathology of Parkinson's disease (PD). These oligomers are now believed to be responsible for the cellular toxicity, although they are transiently populated and hence uncharacterized by traditional methods. In addition, we have developed methods to directly visualize aggregated protein inclusions inside live neuroblastoma cells using confocal imaging. The effect of solution crowding (either inside cells or by using synthetic crowding agents) on protein



folding and stability has been extensively studied at single molecule resolution.

Using a combination of biophysical spectroscopy and computational biology and employing two model proteins, we have shown that the folding of these proteins proceed through the accumulation of an alpha helical intermediate, although the native states of them are predominantly beta sheet. Subsequently, we have identified in both proteins a number of molecular switches, which regulate the population of alpha helix and beta sheets. The directionality of these swiches may depend on multiple factors, including the nature of proteins, the experimental conditions and the presence of mutational stresses.

Future Research Plans

To study the conformational stability of SOD1, a key participant of anti-oxidant defense mechanism.

Structure determination of transient oligomeric species, which form early in the aggregation process of several proteins, using a host of structure biology techniques.

PUBLICATIONS

Kundu A., Kundu S. and Chattopadhyay K. (2017) The presence of non-native helical structure in the unfolding of a beta-sheet protein MPT63. *Protein Sci* **26,** 536-54

Sannigrahi A., Maity P., Karmakar S. and Chattopadhyay K. (2017) Interaction of KMP-11 with phospholipid membranes and its implications in leishmaniasis: effects of single tryptophan mutations and cholesterol. *J Phys Chem B* **121,** 1824-1834

Sarkar-Banerjee S., Chowdhury S., Paul S.S., Dutta D., Ghosh A. and Chattopadhyay K. (2016) The non-native helical intermediate state may accumulate at low ph in the folding and aggregation landscape of the intestinal fatty acid binding protein. *Biochemistry* **55,** 4457- 446.

Paul S.S., Sil P., Chakraborty R., Haldar S. and Chattopadhyay K. (2016) Molecular crowding affects the conformational fluctuations, peroxidase activity, and folding landscape of yeast cytochrome c. *Biochemistry* **55,** 2332-2343

EXTRAMURAL FUNDING

Investigation of the folding and aggregation landscape of superoxide dismutase in vitro and in live cells: its implications in Amyotrophic lateral sclerosis (ALS), 45.94 lakhs from the Department of Science and Technology, The Government of India

CONFERENCES / WORKSHOPS

Number of abstracts

India: 5 International: 1

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

Neuro Update in CSIR-IICB, 26th November, 2016, Kolkata.

INVITED TALKS

Small molecule based investigation on different stages of alpha synuclein aggregation, Neuro Update, CSIR-Indian Institute of Chemical Biology, 26 November, 2016, Kolkata, India.

Early conformational fluctuations vs. oligomerization: surface residues may have a say; International Protein Folding Meeting; National Centre for Biological Sciences (NCBS) 9-11, November, 2016, Bangaluru, India.

Alpha-Synuclein: Fibrils, oligomers and beyond; Neurocon 2017; 19-22 January, 2017, Haldia India.

Protein conformation, dynamics and aggregation: One molecule at a time; 12th. National Symposium on Radiation and Photochemistry 2-4 March, 2017.

Early conformational fluctuations vs. oligomerization in cytochrome c: one molecule at a time; Symposium on the Advances in Bio-Inorganic Chemistry (SABIC), organized jointly by the Tata Institute of Fundamental Research (TIFR-Mumbai) and Indian Association for the Cultivation of Science (IACS) 7-11 January, 2017, Kolkata ,India.

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Elucidating functional mechanisms of macromolecules from their 3D structures determined by cryo-electron microscopy

Participants

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Structural Biology & Bioinformatics Divison

Background

The research of my lab is primarily focused on the structure and dynamics of the molecular machine, ribosome. All living organisms utilize ribosome to translate messenger RNA (mRNA) into proteins. The ribosome's function is one of the most fundamental processes of life, and intense efforts are going into elucidating the underlying mechanisms of ribosome-related processes.

Our group primarily uses structural biology (cryo-electron microscopy (Cryo-EM) in conjunction with Single Particle Reconstruction technique) tools to delineate yet-unknown interactions of several regulatory factors (potential targets for antimicrobial drugs) with the bacterial ribosome, particularly the proteins involved in the ribosome biogenesis (e.g. conserved GTPase HflX), and enzymes involved in nascent polypeptide chain processing (e.g. N-terminal deformylation (PDF) and methionine excision (MetAP)).

We also have initiated structural studies employing cryo-EM on other macromolecular assemblies involved in crucial cellular functions (in collaboration with other groups).

Aims & Objective

- We aim to structurally characterize biological macromolecular assemblies involved in important cellular processes (and thus are potential drug targets). Comprehensive structural understanding of the macromolecules has the potential to build new concepts and their innovative applications in the research fields of bacterial infection, and diseases like Alzheimer's, diabetes etc.

Work Achieved

Protein synthesis in bacteria is initiated with N-formyl methionine. Following synthesis, the nascent protein is subjected to N-terminal processing catalyzed by two enzymes, peptide deformylase (PDF) and methionine aminopeptidase (MAP), involved in two proteolytic pathways needed to produce diverse N termini in proteins. The tunnel exit is surrounded by four ubiquitously conserved ribosomal proteins along with 23S rRNA helices and these ribosomal components play a key role in regulating association of the enzymes that act upon the nascent polypeptides emerging from the exit tunnel.

We have generated cryo-EM structures of *E. coli* 70S ribosome bound to PDF (70S-PDF) and MAP (70S-MAP). Our study reveals that PDF and MAP interact at overlapping region of tunnel exit when bind sequentially.

Future Research Plans

Structural elucidation of ribosome-related, yet-unknown mechanisms in pathogenic bacteria that can be potential drug targets and structure-guided designing of inhibitors

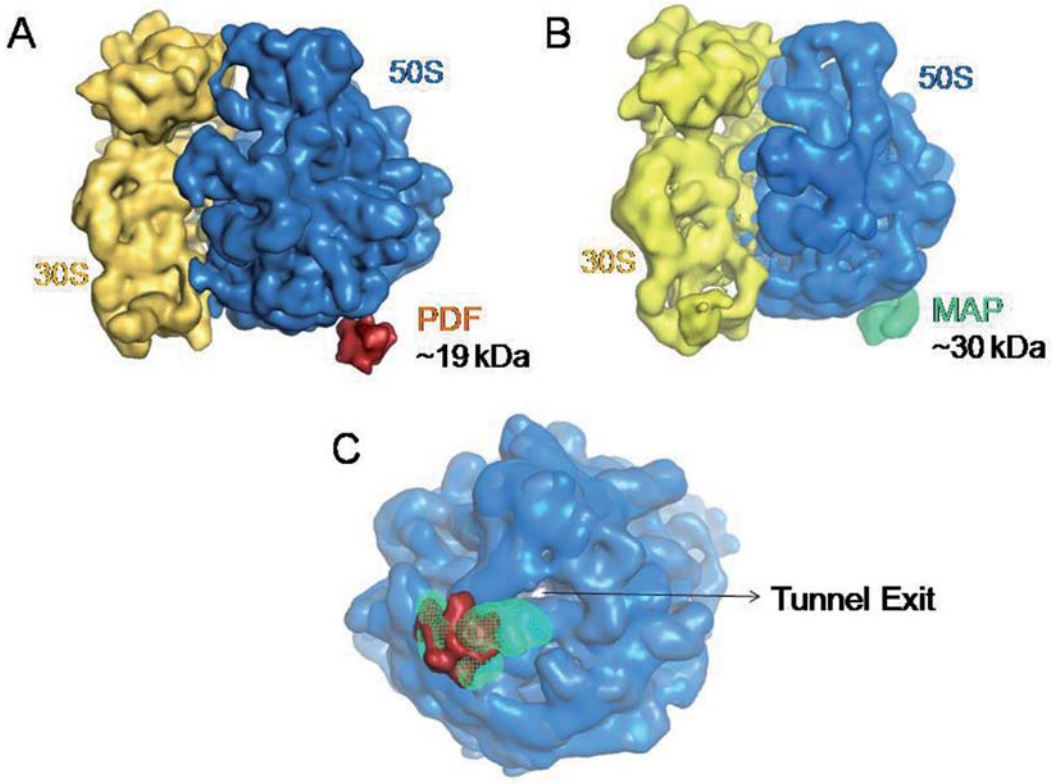

Fig. 1: Ribosome-binding of the *E. coli* nascent chain processing enzymes. (A) 70S ribosome bound to the protein peptide deformylase (PDF, brown) (B) 70S ribosome in complex with the protein methionine aminopeptidase (MAP, cyan) (C) View of the tunnel exit (through which nascent chain emerges) showing overlapping binding sites of PDF and MAP. The 30S and 50S subunits are shown in yellaw and blue respectively.

PUBLICATIONS

Chakraborty B., Bhakta S. and Sengupta J. (2016) Mechanistic insight int the reactivation of bcaii enzyme from denatured and molten globule states by eukaryotic ribosomes and domain V rRNAs. *PLoS One* **11,** e0153928

Chakraborty B., Sejpal N.V., Payghan P.V., Ghoshal N. and Sengupta J. (2016) Structure-based designing of sordarin derivative as potential fungicide with pan-fungal activity. *J Mol Graph Model* **66,** 133-142

AWARDS / HONOURS / MEMBERSHIPS

'N.N. Dasgupta poster award' in Indian Biophysical Society meeting (23rd-25th March, 2017) held at IISER, Mohali

EXTRAMURAL FUNDING

Processing of the Nascent Polypeptide Chain on Mycobacterium 70S Ribosome: Structural and Functional Studies. 2015-2018 (DST (SERB), India)

CONFERENCES / WORKSHOPS

Number of abstracts

India : 1

INVITED TALKS

'Frontiers in Biotechnology' St. Xavier's College, 4th October, 2016, Kolkata

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Understanding the molecular mechanisms underlying systemic diseases and host-pathogen interactions

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Project Assistant: Manas Bhowmik

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Simanti Datta
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Dr. Susanta Roy Chaudhury & Dr. Chitra Mandal
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Dr. S.N. Bhattacharyya & Dr. Kunal Ray
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Dr. Partha Chakrabarti
Cell Biology & Physiology Division

Background

My team is actively involved in identifying important biomolecular interactions involving proteins, DNA and other macro molecules in diseases like cancer and infectious diseases. For a major part of our scientific research, we utilize advanced level genomics, transcriptomics, and proteomics data to understand and decipher their biological significance via meta-interactome analysis. Our group is also actively involved in developing various computational tools, techniques and web servers, which are freely available for users and are beneficial to the scientific community throughout the world. Following are the two main contributions from the lab so far:

- Identification of important interacting proteins (IIPs) and potential drug targets in parasites such as *Plasmodium falciparum* and *Leishmaniadonovaniusing* network biology and graph theoretical approaches. We have also developed a useful pipeline namely, PALM-IST, to identify key important interactions, proteins and pathways involved in various cancer scenarios utilizing genomics, transcriptomics, and proteomics data via meta-interactome analysis.
- Establishment of state-of-the-art molecular modelling, docking and simulation protocols to dissect the molecular mechanisms of key protein-protein interactions.

Aims and Objectives

- To construct and analyze the protein-protein interactions (PPI) networks of host-pathogensystem.
- To understand the hidden properties of systemic disease via using network biology and graph theoretical approaches.

Work Achieved

Systems biology of host-pathogen interactions

Network analysis in *Leishmania:* We have studied the human pathogen, *Leishmania* sp. by compiling and analyzing the whole protein interactome data of *Leishmania* sp. The constructed network has been further considered for identifying important interacting leishmanial protein(s) of the network to understand their involvement in pathogen survivability and pathogenicity. With the aim of studying protein interaction properties both at systems and molecular level, we have implemented bioinformatics tools towards identification and characterization of some virulence factors of the parasite. In this respect, we have identified a novel target protein using the network biology approach and its probable inhibitor using High Throughput Virtual Screening (HTVS) technique. Moreover, we have tried to understand and compare the difference in *Leishmania* infected macrophage de-regulated genes of early and late phase of infections based on their pathway and functional involvement to highlight specific functions of stage-specific genes.

Systems biology of cancer

We have developed a computational systems biology approach to build a meta-interaction network of signaling, metabolic and regulatory pathways within cellular systems using text mining, network assembly and graph theory approaches to understand complex diseases like glioblastoma and cervical squamous cell carcinoma (CSCC). Our integrative genomic analysis identified novel copy number variants associated with the development of advanced cervical squamous cell carcinoma. In order to understand complex biological networks and to identify proteins with important interacting partners we have postulated a node effect property. Node effect is a weighted network property based on differential expression at genomic level, differential expression at transciptomic level, rate limiting enzyme and signaling cross-talk proteins involved in the interaction network. Thus, we considered functional knowledge of pathways, expression and regulatory features such as rate limiting enzymes or cross-talk genes/proteins to identify key interactors of the novel genes within copy number varying loci involved in development of advanced CSCC **(Fig. 1).**

Application of sequence/structural biology approaches to understand host-pathogen interactions, complex diseases or metabolic disorders

We also utilize molecular modelling, molecular docking and sequence analysis approaches to address host-pathogen interactions. In this respect, we have identified an internalin-A like class of virulence factors in *Leishmania* sp. with the help ofextensive sequence-profile and profile-profile sequence comparison-based methods. Further, we explored the possibility whether *L. donovani* can adopt similar subversion mechanism in host cells as Inl-A from *L. monocytogenes*.We addressed this issue based on homology modeling of *L. donovani* Inl-A-like proteins and their subsequent docking studies with the host interaction partner (human E-cadherin [hEC1]) of their bacterial ortholog (Inl-A) **(Fig. 2).** Based on these analyses, we suggested the existence of a new group of virulence factor(s) in *L. donovani* and other *Leishmania* sp. capable of employing a yet to be known mode of host invasion mechanism. We have also performed in silico modeling of the HBV RT domain and mutational mapping thereof to evaluate the structure of HBV quasispecies in Lamivudine (LMV)-failed chronic hepatitis B (CHB) patients and its impact in defining the subsequent virological responses to Tenofovir (TDF)-based rescue-therapy. Further, we have utilized molecular modelling and structural analyses approach to understand ATGL regulation by COP1 in the context of metabolic disorder like diabetes **(Fig. 3).**

Future Research Plans

We would like to explore metabolic reprogramming in cancer cells with a combination of network and systems biology approaches to understand the molecular mechanism this metabolic switch.

Further, with the help of a multi-faceted research plan by integrating experimental information with subsequent development of computational techniques we will be able to better address systemic diseases and host-pathogen interactions.

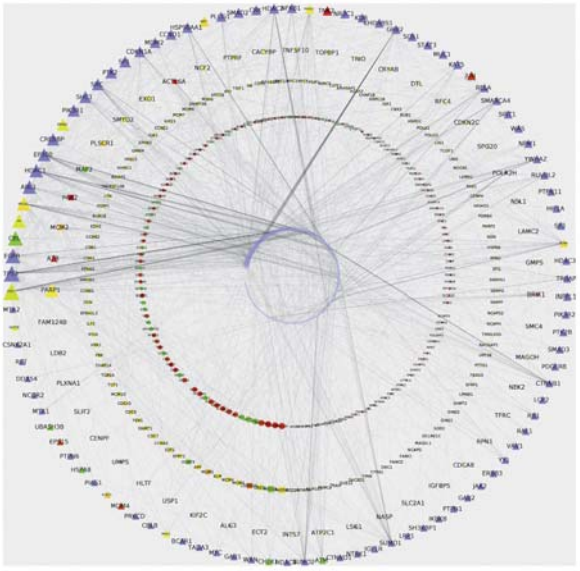
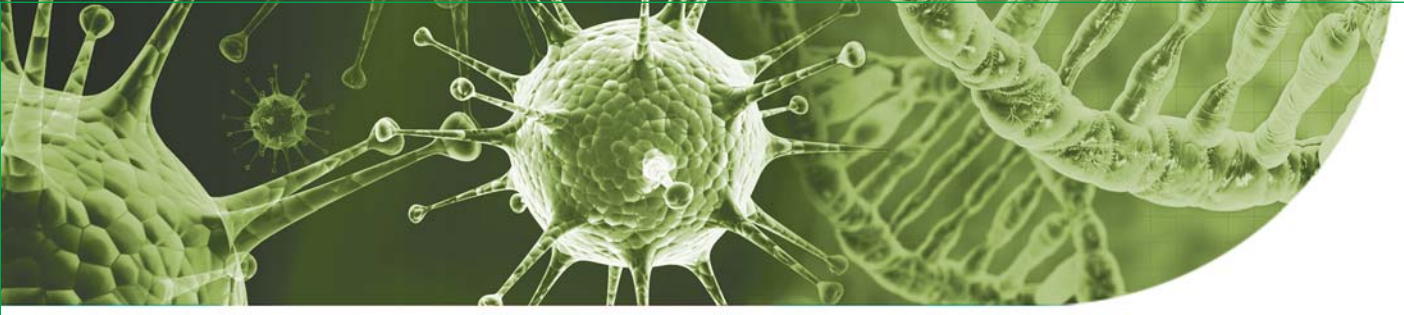


Fig. 1: Cervical cancer related protein's interaction sub-network (CCIN) represented 1903 nodes based on weighted network analysis. The size of the nodes/genes increased with the score (according to node effect property). Triangle shaped nodes (outer most circle) were the top 100 based on the scores. The represented colour (red: up-regulation to green: downregulation) of the nodes was based on the copy number (n = 2) and/or expression (n = 3) values available for all the genes in CSCC datasets used in the present study. The circle next to it showed the identified 78 genes (deregulated at both genomic and transcriptomic level) and among them PARP1 and ATR (triangle shaped) were among the top 100 gene rank. Next two circles are for genes deregulated at transcriptomic and CNV (octagon shaped) respectively. The innermost circle represented the genes which had no copy number variation and/or expression values available in CSCC datasets used in the current investigation.



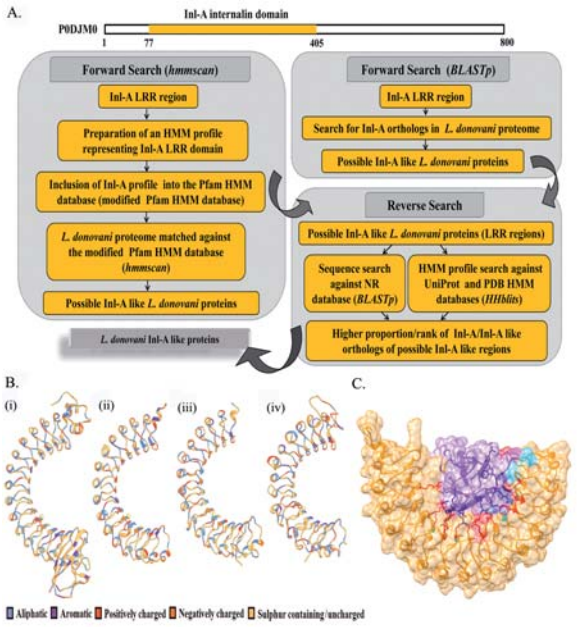


Fig. 2: Basic methodology for identification of *L. donovani*Inl-A-like proteins. A) Outline of the basic search strategy to identify *L. donovani*Inl-A-like proteins. B)Internalin-A (i) and 3D models of identified *L. donovani*Inl-A-like proteins [E9B7L9 (ii), E9BMT7 (iii), E9BUL5 (iv) respectively](Amino acid residues are coloured based on the nature of residues). C)Representative docked complex of *L. donovani*Inl-A-like protein and E-cadherin [hEC1]). Abbreviations: Inl-A, Internalin-A; LRR, Leucine Rich Repeat; HMM, Hidden Markov Model; BLAST, Basic Local Alignment Search Tool; HHblits, HMM-HMM-based lightning-fast iterative sequence search tool.

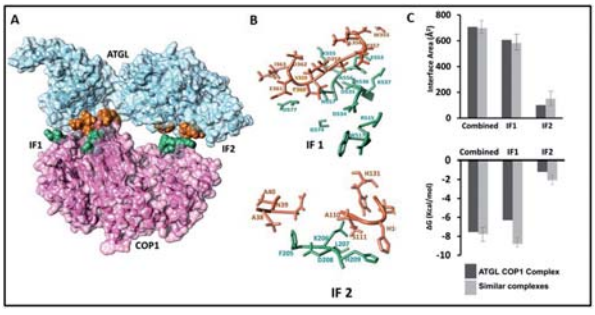


Fig. 3: (A) Docked complex of ATGL (blue) and COP1 (pink). Interface residues are shown as spheres in orange (ATGL) and green (COP1) colors, respectively. ATGL and COP1 interact through two interfaces marked as IF1 and IF2. (B) IF1 and IF2 are enlarged and the residues are represented in stick orientation. (C) Interface area (top panel) and gain of solvation free energy (bottom panel) of docked complex are compared with the same obtained from 8 different protein complexes having interface area of similar sizes.

PUBLICATIONS

Banerjee P., Chakraborty A., Mondal R.K., Khatun M., Datta S., Das K., Pandit P., Mukherjee S., Banerjee S., Ghosh S., Chakrabarti S., Chowdhury A. and Datta S. (2017) HBV quasispecies composition in Lamivudine-failed chronic hepatitis B patients and its influence on virological response to Tenofovir-based rescue therapy. *Sci Rep* **7,** 44742

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Bathula C., Ghosh S., Hati S., Tripathy S., Singh S., Chakrabarti S. and Sen S. (2017) Bioisosteric modification of known fucosidase inhibitors to discover a novel inhibitor of α-L-fucosidase. *RSC Adv* **7,** 3563-357

Roychowdhury A., Samadder S., Das P., Mandloi S., Addya S., Chakraborty C., Basu P.S., Mondal R., Roy A., Chakrabarti S., Roychoudhury S. and Panda C.K. (2016) Integrative genomic and network analysis identified novel genes associated with the development of advanced cervical squamous cell carcinoma. *Biochim Biophys Acta* **1861,** 2899-2911

Mukherjee I., Chakraborty A. and Chakrabarti S. (2016) Identification of internalin-A-like virulent proteins in Leishmaniadonovani. *Parasit Vector* **9,** 557

Ghosh M., Niyogi S., Bhattacharyya M., Adak M., Nayak D.K., Chakrabarti S. and Chakrabarti P. (2016) Ubiquitin Ligase COP1 controls hepatic fat metabolism by targeting ATGL for degradation. *Diabetes* **65,** 3561-3572

EXTRAMURAL FUNDING

Title of the project: Role of sialylated glycan on Pseudomonas aeruginosa in interaction with innate immune cells: A glyco-proteomics approach.

Role: PI

Funding Agency: DBT

Tenure of the Funding: 2016-1019

Title of the project: Compartmentalization of microRNA-Dependent Post-transcriptional Processes in Mammalian Cells: Role of Sub-cellular Structures and Organelles.

Role:Co-PI

Funding Agency: DST

Tenure of the Funding: 2017-1010

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Structure and functional aspects of disordered human proteome

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Background

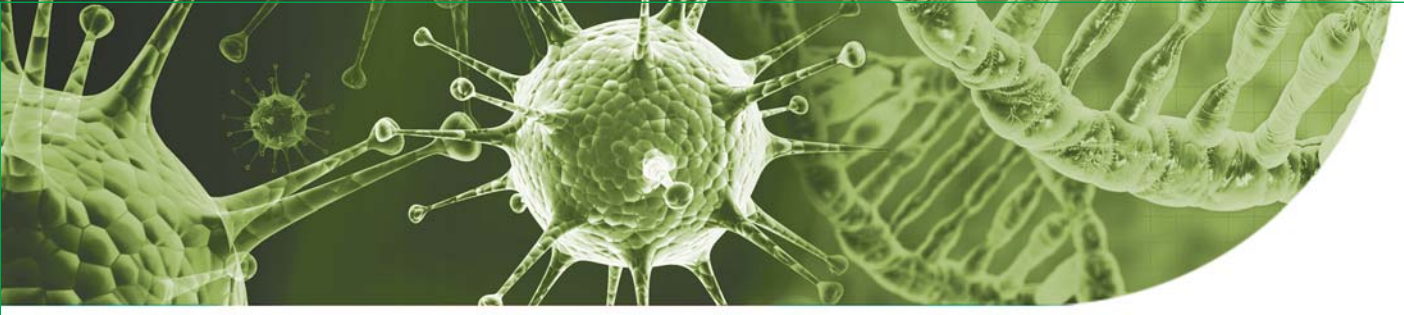
A protein inside cell does most of the function and in this regard the structure and solution state stability of protein is very crucial. Several folded domain in a protein structure may be interconnected via protein disordered regions. Many proteins again maintain their stability mainly being intresnsically disorder. In this regard an unique stability between folded domain and disordered regions is required for proteins function. The presence of such large content of disorder regions in a protein is believed to confer suitable plasticity to interact efficiently with several targets, as compared with a globular protein with limited conformational flexibility. We investigated effect of metal ions on antimicrobial plant protein purothionine and amyloid beta peptides. We also made some computational work on disordered human proteome.

Aims & Objective

- Classical notion is that well defined 3D protein structure is pre-requisite for its function and this has been challenged. It may be a very simplistic view and true for action of proteins on small molecules. Recent studies indicates that a large number of proteins or regions of proteins are intrinsically disordered (ID). The lack of a rigid and folded stable structure may add large plasticity to intrinsically disordered proteins (IDPs) and allow it to interact efficiently with different targets, as compared to a globular protein with limited conformational flexibility. These characteristics aid good efficacy to IDPs in cell cycle regulation, membrane transport, different molecular recognition processes. One of the research objectives of our group is to provide a description and behaviour of IDPs in different solution conditions and in living cells. Further we attempt to define the role of this class of proteins in cell signalling and their implication in neurological disorder including amyloid diseases. Our target proteins are alpha-synuclein, amyloid beta peptide, tau and their fragments and hemoglobin. Special attention is on amyloid beta peptide and alpha-synuclein to know the mechanisum of cytotoxc effect.

Work Achieved

Antimicrobial plant protein purothionin plays a crucial role in immunity and microbial defense systems in plants and animals. Engazing molecular simulation analyses and spectroscopic methods we observed that the structural arrangement of the protein tetramer attained much more stable and compact conformation in the presence of calcium and magnesium compared to the tetramer alone in the absence of ions. We can find that the folded secondary structure in the presence of calcium and magnesium ions was observed. The circular dichroism spectral analysis and FT-IR study along with molecular dynamics simulation studies suggested some increase in the helical content/compactness of the protein. Structural stability of the protein, as observed, may be linked to increased antifungal activity against pathogens like Candida albicans, Candida krusei and Candida parapsilosis. We further worked on amyloid betapeptide and its conformational state in different solution conditions.



We further investigated the aggregation aspects of disordered human proteins. Proteins containing amyloidogenic segments has a natural tendency to form amyloid aggregates. Both the structured and disordered proteins can form amyloid aggregates under suitable solution conditions.. Our analysis indicated that the sequence composition and the physicochemical properties such as isoelectric point (pI), hydrophobicity, aliphatic index (AI) and instability index (II) of amyloidogenic and non-amylidogenic proteins differed in large extent. However, unique to our finding is that such differences appeared to be exclusive for intrinsically disordered proteins. Structured amyloidogenic proteins were found to be more similar to their non-amyloidogenic counterparts except for their sequence composition and the distribution of their isoelectric points. Recently we showed from the sequence analysis that the distinction between amyloidogenic and non-amyloidogenic proteins is much wider in case of disordered proteins than the structured proteins.

We also reported the binding interaction of GABA derivative, methyl 4-(4-((2-(tert-butoxy)-2-oxoethyl)(4-methoxyphenyl)amino)benzamido)butanoate with serum albumin in collaboration with Dr. Biswadip Banerjee. Molecular docking studies by various different algorithms showed that the compound binds to the groove between domain I and domain III of BSA and within the domain I in case of HSA. Molecular dynamics analysis showed that the compound forms stable complexes with the serum albumins.

Future Research Plans

- Structural spects of proteins and peptides those form neurotoxic aggregates
- Structural implication of protein oligomers in several disease formation
- Role of metal nanosurface on protein aggregation

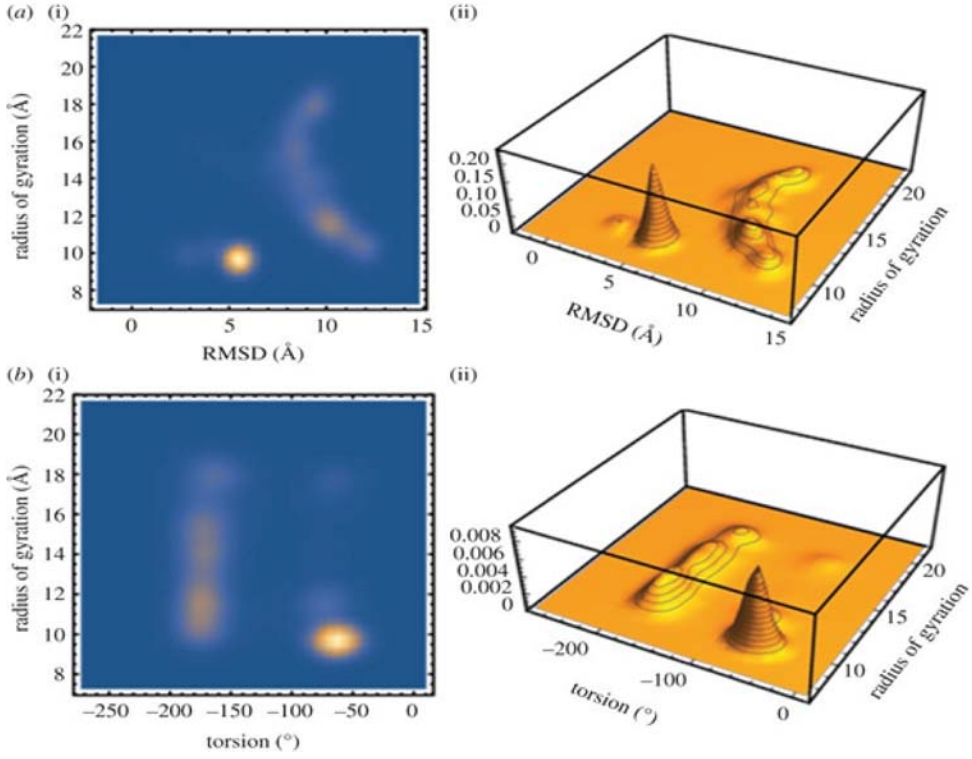
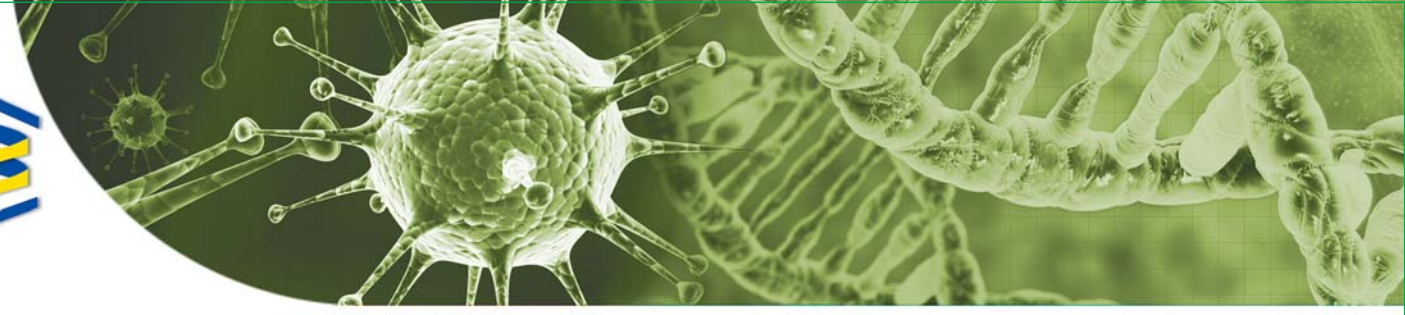


Fig. : Conformation clustering of amyloid beta peptide which is implicated in Alzheimer's Disease. The conformational clustering based on the radius of gyration with RMSD values obtained from the sets of trajectory, with contour plot of radius of gyration with RMSD (i) and three-dimensional histogram plot (ii). b(i,ii) The conformational clustering based on correlation between radius of gyration and dihedral/torsion angle obtained from the sets



PUBLICATIONS

Envisaging structural insight of a terminally protected proline dipeptide by raman spectroscopy and DFT analyses, Das S., Pal U., Chatterjee M., Pramanik S.K., Banerji B., Maiti N.C. 2016, *J. Phys. Chem. A,* DOI: 10.1021/acs.jpca.6b10017.

Metal ions provide structural stability and compactness to tetrameric purothionin, RSC Advances, Das S., Pal U. and Maiti N.C. 2016, *RSC Advances,* **6,** 90690-90700, (DOI: 10.1039/C6RA16576A)

Origin of protein aggregation: identification of some characteristic traits in structured and intrinsically disordered proteins, Pal U., Roy A., Das S., Das S., Kundu M., Bagga K., Maiti N.C. Vol 7, No 4 (2016), *J. Proteins and Proteomics*

Orientation of tyrosine side chain in neurotoxic Aβ differs in two different secondary structures of the peptide, Das S., Roy A., Pal U. and Maiti N.C. 2016, *R. Soc. Open Sci.* 3: 160112

A novel spirooxindole derivative inhibits the growth of *Leishmania donovani* parasite both *in vitro* and *in vivo* by targeting type IB topoisomerase, Saha S., Acharya C., Pal U., Chowdhury S.R., Sarkar K., Maiti N.C., Jaisankar P., Majumder H.K. 2016 *Antimicrob Agents Chemother.* 60, 6281-93. doi: 10.1128/AAC.00352-16.

Interaction of T-state haemoglobin and phytochemicals of Hygrophila spinosa T. Anders: an approach by molecular docking, Talapatra S.N., Talukder P., Pal U., Maiti N.C. and Swarnakar S. 2016 *World Journal of Pharmaceutical Research,* 51354-1369 · DOI: 10.20959/wjpr20169-6866

Pal U., Pramanik S., Bhattacharya B., Banerji B. and Maiti N.C. Binding interaction of a gamma-aminobutyric acid derivative with serum albumin: An insight by fluorescence and molecular modeling analysis. 2016. *Springerplus. 5, 1121. doi: 10.1186/s40064-016-2752-x.*

Naiya G., Raha .P, Mondal M.K., Pal U., Saha R., Choudhury S., Batabyal S., Pal S.K., Bhattacharyya D., Maiti N.C. and Roy S. Conformational Selection Underpins Recognition of Multiple DNA sequences by proteins and consequent functional actions, 2016 *Phys.Chem.Chem.Phys.,* DOI: 10.1039/C6CP03278H

Banerji B., Chandrasekhar K., Killi S.K., Pramanik S., Pal U., Sen S., Maiti N.C., Silver-catalyzed azide–alkyne cycloaddition (AgAAC): Assessing the mechanism by DFT, *R. Soc. open sci.* 3: 160090.http://dx.doi.org/10.1098/rsos.160090

Mitra P., Pal U., Maiti N.C., Ghosh A., Bhunia A. and Basu S. Identification of modes of interactions between 9-aminoacridine hydrochloride hydrate and serum proteins by low and high resolution spectroscopy and molecular modeling, *RSC Adv.,* 2016, 6, 53454

Banerji B.,Chatterjee M., Paul U. and Maiti N.C. Molecular details of acetate binding to a new diamine receptor by NMR and FT-IR analyses, *J. Phy. Chem. A.* 2016, 120, 2330-2341

CONFERENCES / WORKSHOPS

Number of abstracts India: 4 International : 1

CONFERENCES / EVENTS ORGANIZED BY CSIR-IICB

Trans-Synaptic Toxicity of Alpha-synuclein Oligomers (Animesh Mandal, Anupam Roy, Mrityunjoy Maity, Uttam Pal, Sandip Dolui, Kaushik Bera, Krishnendu Khamaru and Dr. N.C. Maiti), 3rd International Meet on Advanced Studies in Cell Signalling Network (CeSiN), 18-20 December, 2016, CSIR-Indian Institute of Chemical Biology, Kolkata-700032, India

INVITED TALKS

1. Invited Speaker in 30th Annual Meeting of Society For Neurochemistry India (SNCI), Dec 9-11, 2016, CSIR- Centre for Cellular and Molecular Biology (CCMB), Hyderabad-500007, India

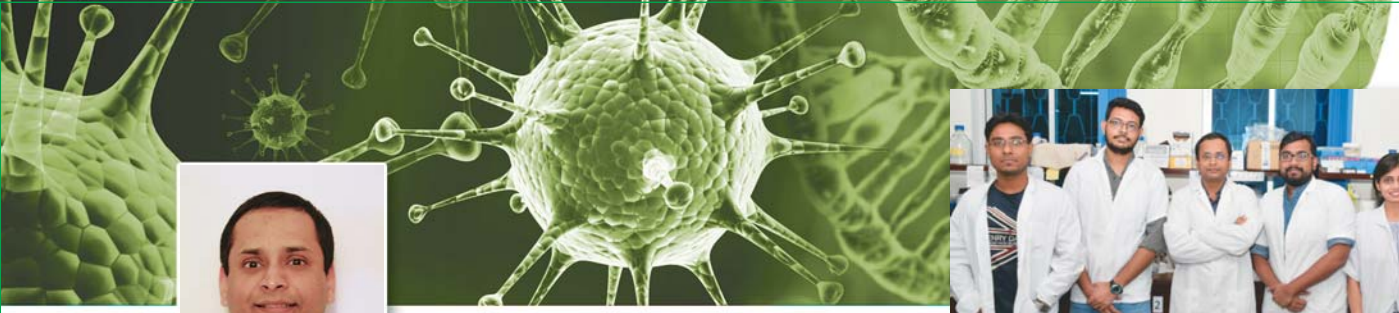
2. Invited Speaker, National Workshop on Technology Up-Gradation and Pharmaceutical\promotion, July 29-30, 2016, National Institute of Pharmaceutical Research (NIPER), Kolkata

3. Invited Speaker, 10th Year Celebration of Excellence in Science at IISER, Kolkata

4. Invited Speaker, Neuroupdate, Nov 26, 2016, CSIR-Indian Institute of Chemical Biology, Kolkata-700032

5. Invited as a chair person in Symposium on Nutraceuticals, 27-29th January, 2017, NIPER, Kolkata

6. Invited as a chair person in 3rd International Meet on Advanced Studies in Cell Signalling Network (CeSiN), 18-20 December, 2016, CSIR-Indian Institute of Chemical Biology, Kolkata-700032, India



Dr. Sujoy Mukherjee

sujoym@iicb.res.in

Role of protein's structure and dynamics in function and and disease propagation

Participants

JRF: Sukanya Mozumder, Sayan Bhattacharjee

SRF: Gopa Mahesh, Jitendra Kumar Das, Juhi Augusta Rasquinha, Shyam Sunder Mall, Aritra Bej

Background

Proteins exist in multiple states and detailed information of how they interconvert between its various conformations can be helpful in understanding their physiological functions. This knowledge can be helpful in understanding how their malfunction cause diseases and help develop therapies to overcome them. It has been shown that inter-conversion between protein's conformers occur via sparsely populated intermediate states. But their short-lived nature and low population makes them difficult to study by standard biophysical methods.

Aims and Objectives

- To characterize *invisible* states of proteins those are formed transiently between two visible, observed states
- To investigate the structure, dynamics, ligand and cholesterol interaction of GPCRs

Work Achieved

NMR spectroscopy is an emerging technique that can be used to study biomolecular structure, dynamics and ligand interactions. It can also be used to probe transiently formed intermediate states of proteins that are difficult to observe by standard biophysical methods. Our lab has applied NMR spin relaxation methods to report the existence of non-native conformers of an amyloid forming protein, transthyretin, which is a thyroxine transporter protein but implicated in a number of senile and familial forms of amyloidosis. We have used solution NMR and MD simulations to characterize the residue specific conformational flexibility of transthyretin and identified its dynamic hot-spots. Our research provides a biophysical explanation for the higher pathogenicity of the mutant forms of the protein in comparison to the wild type. In addition, we also studied the backbone dynamics of DNA binding domain of p53 that is known to be site for a majority of high frequency oncogenic mutations. Comparative analysis of dynamic behaviour of the wild type p53 and its important hot-spot mutations reveal important insights into the basis of instability of mutant p53, which may play a role in its gain-of-function phenomena as well. Another promising chapter of our work involves the cloning, expression, purification of serotonin GPCRs using baculoviral expression system in insect cell lines. Preliminary results from our group show important changes in the serotonin GPCR in presence of cholesterol, which could have important implications for patients with hypercholesterolemia.

Future Research Plans

The future plan of our laboratory is to continue investigating these systems to develop a comprehensive understanding of their biomolecular function. In addition, we would also expand the scope of these studies into other biomolecules that are known to be relevant in diseases ranging from tuberculosis to mental health and cancer.

EXTRAMURAL FUNDING

Ramanujan fellowship, 2011 – 2016. (DST, India)

Investigating the dynamic interactions of a toxin-antitoxin module of Mycobacterium tuberculosis by NMR spectroscopy. 2015 - 2018. (DST, India)

Sujoy Mukherjee & P. K. Madhu

Transiently formed non-native conformers of transthyretin: structure, function and their roles in formation of amyloid fibrils, 2017 – 2020. (DBT, India)

CONFERENCES / WORKSHOPS

Number of abstracts

India: 1

INVITED TALKS

Is partial unfolding of native proteins a necessary, inaugural step in amyloidosisIISc/Asia-Pacific NMR Conference; February 2017 Bengaluru, India.

Dr. Sucheta Tripathy
tsucheta@iicb.res.in

Piecing together genomes of microbes for exploring the biological treasure trove

Participants

JRF: Mayuri Mukherjee

SRF: Lubna Sheikh, Subhadeep Das, Abhishek Das, Mathu Malar C., Arijit Panda, Samrat Ghosh

RA: Deeya Sen, Rajib Majumdar

Project Assistant: Vinneta Verma

Collaborator(s)

Collaborators outside CSIR-IICB

Prof. Sanjoy Guha Roy
West Bengal State University,West Bengal.

Prof. Anindita Seal
University of Calcutta, West Bengal.

Prof. Siba Prasad Adhikary
Fakir Mohan University, Orissa.

Dr. Shubho Choudhury
Bose Institute, Kolkata.

Dr. Swasthi Tiwari
PGI, Lucknow, UP.

Prof. Brett Tyler
Oregon State University, USA.

Dr. Takao Kasuga
University of California Davies, USA.

Dr. Sophien Kamoun
Sainbury laboratories, UK.

Dr. Ramesh Ventukuri
Sweden.

Collaborators within CSIR-IICB

Dr. Amitava Sengupta
Structural Biology & Bioinformatics Division

Dr. Nahid Ali
Infectious Diseases & Immunology Division

Background

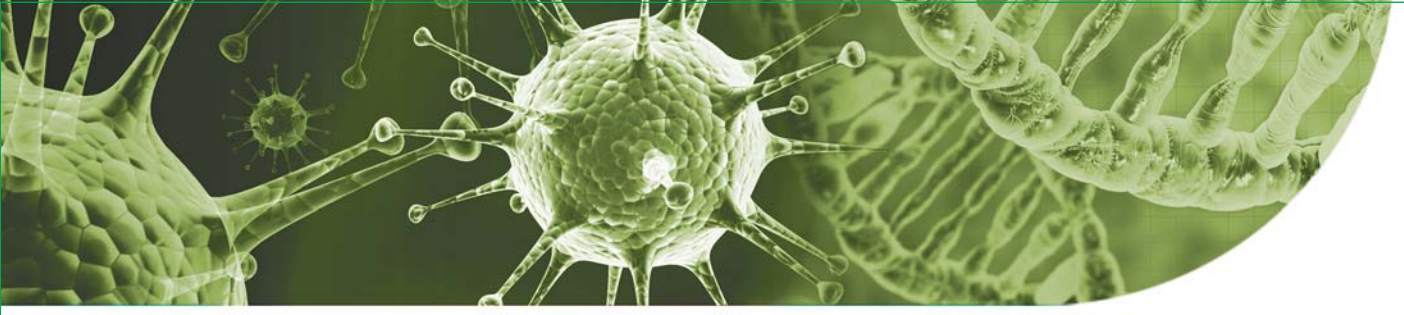
India is a major mega diverse nation with most of its microbial populations lying un-explored. We work on a plethora of organisms belonging to different phylogenetic clades towards solving the biological riddles encoded in their genomes and exploiting them for beneficial purposes. We use existing and in house softwares and some custome made softwares in joining the shorter reads generated by the nextgen sequencing methods into larger contiguous segments. We use these contigs in predicting genes and assigning biological functions into them. We have already sequenced the genomes and transcriptomes of prokaryotic and eukaryotic organisms in discovering major genes including anti-freezing genes in endophytes that helps them sustain in sub-zero temperatures. These genes have huge economic significance. We have been able to over produce cell wall degrading enzymes in some fungal species that can have major implications in paper industry. We have predicted novel effectors that lie in the repeat rich regions of the genomes that evolve faster than other regions of the genomes - re-iterating the two speed genome evolution concept in pathogens. We have created computational resouces for genomic data analysis in forms of light weight genome analyzers. Our interest in prokaryotes centers around photosynthetic Cyanobacteria that grow in extreme environment. These organisms are shown to be extremely rich in signalling molecules that help them adapt quickly to changing environments. They also produce a plethora of secondary metabolites that has huge commercial significance. In future we would like to use this information for commercial level production of bio-enzymes and metabolites and bio-remediation agents.

Aims and Objectives

- Develop biomaterials from the dead cell walls of endophytic fungus and cyanobacteria that has been shown to have remarkable bio-remediation properties.
- Exploit the metabolite producing genes in extremophile cyanobacteria for commercial purposes.

Work Achieved

We have sequenced genomes and transcriptomes of 16 Cyanobacteria and 3 fungi from various habitats. We used both second and third generation sequencing methods for obtaining high depth, high coverage reads that were later assembled into reasonably good sized contigs and scaffolds. After predicting genes encoded in them and checking the genome completeness, we have done comparative genomics to see how well conserved the gene co-linearity is **(Fig. 1).** We have also studied the rate of evolution in effector genes and found a two speed genome in case of pathogens **(Fig. 2).** We have analyzed the genomes of Cyanobacteria and found them to code a plethora of metabolites that have huge commercial significance. In case of a hotspring Cyanobacteria, we found clusters of NRPS (Non-Ribosomal Protein coding genes) that are differentially regulated during



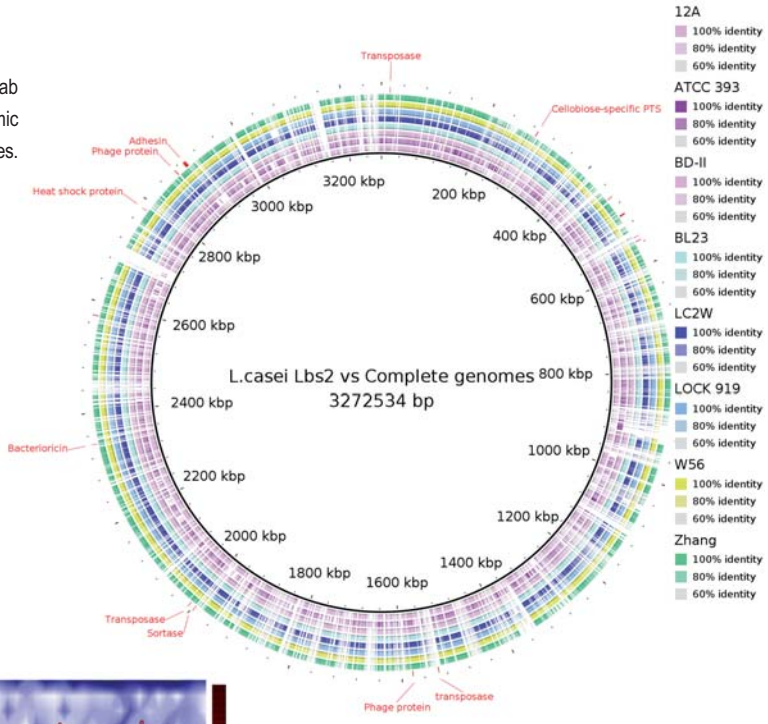


Fig. 1: Comparative genomics data of *X* casei sequenced in our lab versus 8 other fully sequenced relatives. There are several genomic gaps in the other genomes that are exclusively present in out species.

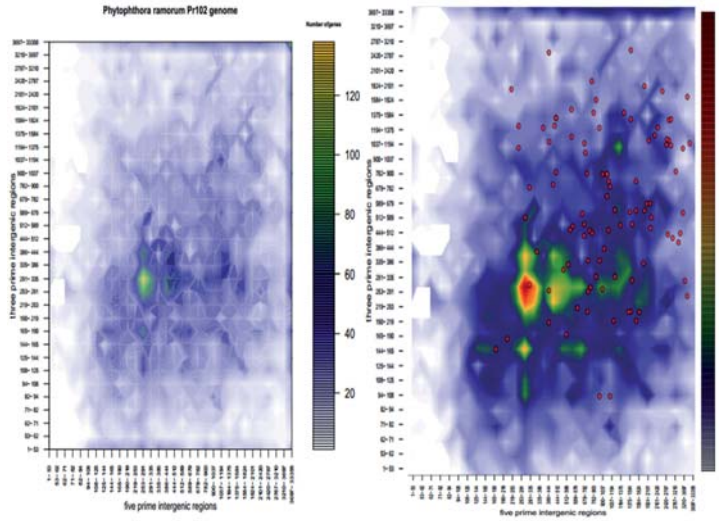


Fig. 2: A) Intergenic regions and their distances in normal genes **B)** Intergenic distances in effector genes. The large distance between the genes suggest that the genes are placed in gene desert regions and repeat rich region. This indicates the genes are undergoing purifying selection.

various types of stressed conditions **(Fig. 3).** We have also been working on genomes of several endophytic beneficial fungus and found amazing bio-remediation properties with their dried cell walls that can adsorb heavy metals such as Iron, lead and Chromium.

Future Research Plans

We are now working towards over production of metabolites as well as other biologically active components from the Cyanobacterial cells. With the fungal dried cell wall, we wish to produce bio-materials that can be directly used for bio-remediation purposes.

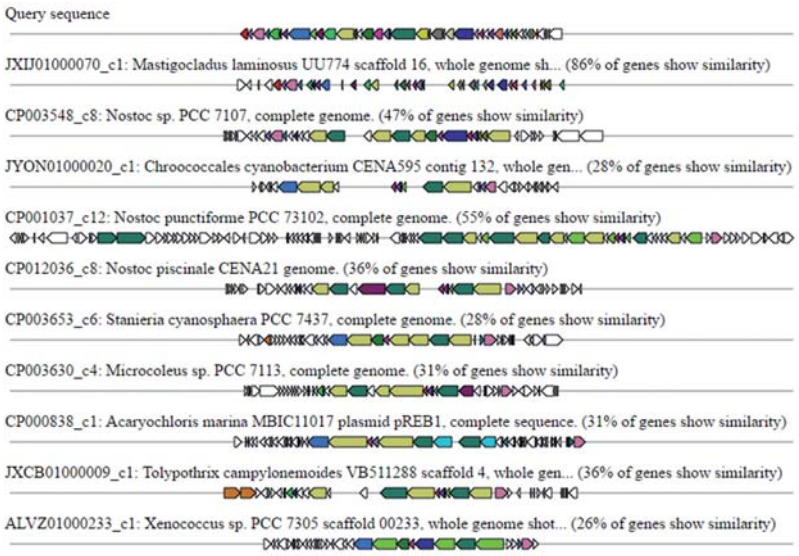


Fig. 3: Non-ribosomal protein clusters in *Mastigocladus laminosus.*

PUBLICATIONS

Panda A., Sen D., Ghosh A., Gupta A., C. M.M., Prakash Mishra G., Singh D., Ye W., Tyler B.M. and Tripathy S. (2016) EumicrobeDBLite: a lightweight genomic resource and analytic platform for draft oomycete genomes. *Mol Plant Pathol* doi:10.1111/mpp.12505

Sheikh L., Tripathy S. and Nayar S. (2016) Biomimetic matrix mediated room temperature synthesis and characterization of nano-hydroxyapatite towards targeted drug delivery. *RSC Advances* **67,** 62556-62571

AWARDS / HONOURS / MEMBERSHIPS

Student's Award

Mathu Malar C.

SERB (DST, Govt of India) full travel award for attending ECCB2016 at Denhague, Netherlands

Sci Genome travel award, for attending and presenting a poster at NGBT16, Cochin, India.

Arijit Panda

OMGN full travel award for a oral presentation entitled "Genome Annotator light(GAL): An integrated virtual machine for genome analysis and visualization", Malmo, Sweden,

Subhadeep Das

Sci Genome full travel award, for attending and presenting a poster atÊNGBT16, Cochin, India.

Rajib Majumdar

Outstanding Paper' award in the 1st Regional Science Congress, 2016 at Presidency Division, West Bengal.

EXTRAMURAL FUNDING

Whole Genome and Transcriptome sequencing of selected cyanobacterial genomes for identification of the role their genes in metabolic pathways related to bio-energy production. 2014-2017.(ICAR, India)

Assessing the genome sequences of Termitomyces clypeatus for novel metabolite discovery through whole genome sequencing methods and characterization of the metabolites for application in biotechnology. 2016-2019. DBT, India

Development of portable system with data analysis and relational data warehouse packages for high throughput structural and functional genomics data. 2017-2020. DBT, India.

CONFERENCES / WORKSHOPS

Number of abstracts

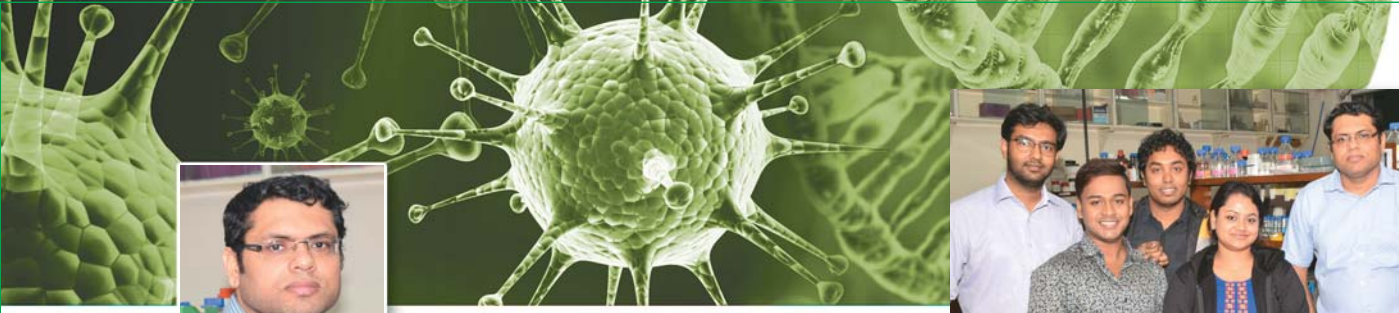
India: 5 International : 4

INVITED TALKS

Improved Phytophthora ramorum Pr102 genome assembly with hybrid assembly protocol. Invited talk, OMGN meeting, June 2016, Malmo, Sweden

Ecological Genome Plasticity: A new age science in the making, Invited talk, One day seminar on Biogenomics. The Asiatic Society, November 2016, Kolkata, India.

Revolutionizing Cyanobacterial Genomics with Next Generation Sequencing approaches, Invited Talk, Second National NGS conference, February 2017, Hyderabad, India.



Dr. Siddhartha Roy
roysiddhartha@iicb.res.in

Structural and functional characterization of a novel histone chaperone TSPYL1, implicated in sudden infant death with dysgenesis of the testes syndrome (SIDDT) in human

Participants

JRF: Sinjini Dhang

SRF: Dushyant Kr. Srivastava, Anirban Dasgupta, Shantanu Adhikary, Sambit Dalui

Collaborator(s)

Collaborators outside CSIR-IICB

Dr. Chandrima Das
Saha Institute of Nuclear Physics, Kolkata

Dr. Vasudevan Seshadri
National Centre for Cell Science (NCCS), Pune

Background

In eukaryotic organisms the genetic information is packaged into a compacted chromatin structure containing nucleosome core particles with 147bp of DNA wrapped around histone octamer (LugerK et al., 1997). All the DNA-mediated activities, including transcription, replication, recombination, and DNA repair use the concerted efforts of histone chaperone protein that facilitates the assembly and disassembly of chromatin by deposition or eviction of histones (De Koning L et al., 2007). The NAP (Nucleosome Assembly Protein) family of histone chaperones is conserved from yeast to human and has been implicated in many biological functions including shuttling histones from the cytosol to the nucleosome, cell proliferation, cell-cycle regulation, transcription, replication, silencing, and apoptosis (Park et al., 2006; Mosammaparast, 2002). TSPYL1, a new member of the NAP protein family, is identified by mapping of sudden infant death with dysgenesis of the testes syndrome (SIDDT) by a SNP genome scan. The primary sequence of TSPYL1 shows that it harbors nucleosome assembly protein (NAPlike) domain. The sequence analysis of the TSPYL1 gene in affected individuals identified a homozygous frame shift mutation (457_458insG) at codon 153, resulting in truncation of translation at codon 169 and thereby leads to loss of NAP like domain. As the loss of NAP domain of TSPYL1 causes the disease in infants, NAP domain of TSPYL may play a role in development by altering regulation of specific developmental genes and contributing to region-specific chromatin remodeling (Puffenberger et al., 2004). Presently there is no structural information available on TSPYL1. The endeavor of the present project is to elucidate the TSPYL1 NAP-like domain structure, which may shed light on its biological function in cellular context.

Aims and Objectives

- Crystal structure determination of NAP-Like domain of TSPYL1 using X-ray crystallography
- To uncover the potential binding partners of TSPYL1
- Biophysical and structural characterization of TSPYL1-histone co-complex
- Role of TSPYL1 in chromatin assembly/disassembly as a histone chaperone

Work Achieved

Full length TSPYL1 gene was cloned from HEK cell-line. We cloned the C-terminal histone chaperone domain of NAP1 (residue 162-416) & (residue 198- 416) from the full length TSPYL1 gene in a pGEX 6p1 vector (Gateway Technologies) containing GST affinity tags. We also cloned full length TSPYL1 (residue 1-416) in pDEST-15 vector having N-terminal GST tag. All the vectors are further confirmed through sequencing. The protein was expressed in bacteria and purified till homogeneity, which will be necessary for the biophysical and crystallization trial **(Fig.1).** Purified TSPYL1 (162-416) was dialyzed in high salt concentration buffer and concentrate up to 8-10mg/mL. Concentrated protein was used to set up several crystallization screens using sitting drop method. Initial hits were obtained in few selected drops. We have shown that TSPYL1 interact with core histones by GST Pull down assay and by AFM study **(Fig. 2).**

Future Research Plans

Identifying and Mapping key histone interacting residues of TSPYL1 using Small Angle X-ray Scattering.

TSPYL1 is a novel regulator of Epithelial Mesenchymal Transition (EMT).

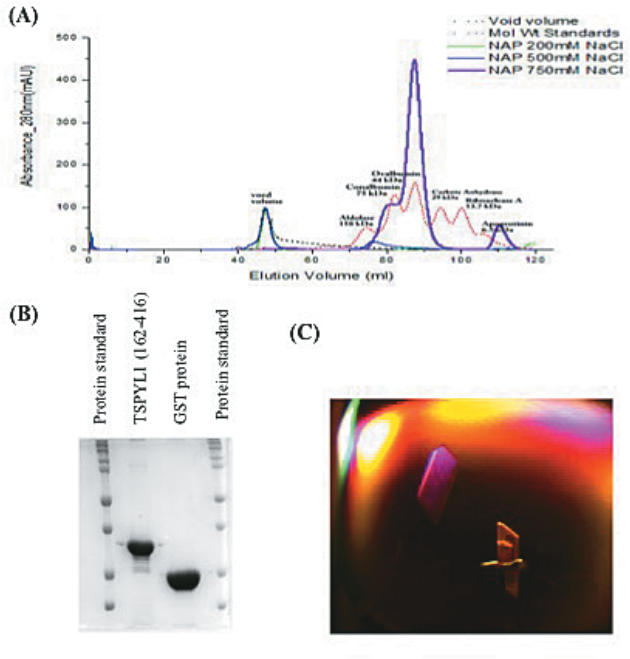


Fig. 1: TSPYL1 purification and crystallization (A) Gel filtration profile of TSPYL1. **(B)** SDS PAGE profile of TSPYL1. **(C)** Crystal of ourified TSPYL1 nap domain

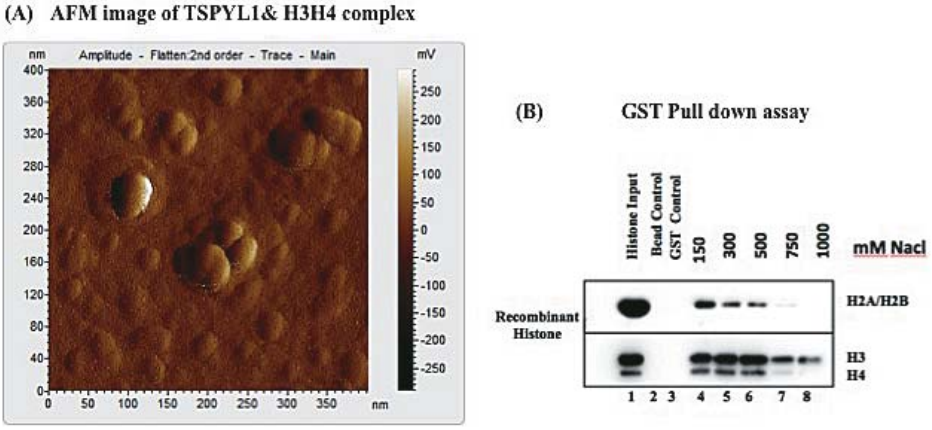


Fig. 2: TSPYL1 interacts with Core histones in vitro (A) AFM images of TSPYL1 & H3H4 complex in 400nm magnification. **(B)** Pull down assay of GST-TspyL1 with Recombinant Histone H3-H4 tetramer and H2A-H2B dimer.

PUBLICATIONS

Basu M., Sengupta I., Khan M.W., Srivastava D.K., Chakrabarti P., Roy S., and Das C. (2017) Dual histone reader ZMYND8 inhibits cancer cell invasion by positively regulating epithelial genes. Biochem J 474, 1919-1934

EXTRAMURAL FUNDING

Ramanujan Fellowship

DST-SERB (EMR/2016/006233)

Intramural funding from CSIR

12th Five Year Plan Projects (IICB NODAL)

Bio-energetic Disorders: A multi-model approach to monitoring and management (BEnD)

Project Code: BSC 0206

Nodal Scientists: Dr. Uday Bandyopadhyay

Participating Institutes (only if IICB is the Nodal Lab): NA

Participating Scientists from IICB: Dr. Rupashri Ain, Dr. Arun Bandyopadyay, Dr. Biswadip Banerji, Dr. Suvendra Bhattacharya, Dr. Subhas Biswas, Dr. Partha Chakrabarti, Dr. Arindam Talukdar, Dr. Indu Bhushan Deb

Understanding and Designing the SupraMolecular Ensembles and Machines (UNSEEN)

Project Code: BBSC 0113

Nodal Scientists: Dr. Jayati Sengupta

Participating Institutes (only if IICB is the Nodal Lab): CCMB, IGIB, CDRI, IMTECH

Participating Scientists from IICB: Dr. Krishnananda Chattopadhyay, Dr. Saumen Datta, Dr. Surajit Ghosh, Dr. Nakul Maiti, Dr. Sujoy Mukherjee, Dr. Siddhartha Roy

Host Interactome analysis: Understanding the Role of Host molecules in Parasitic Infection (HOPE)

Project Code: BSC 0114

Nodal Scientists: Dr. Nahid Ali

Participating Institutes (only if IICB is the Nodal Lab): CDRI, IMTECH, CCMB, NCL

Participating Scientists from IICB: Dr. Subrata Adak, Dr. Nahid Ali, Dr.Suvendra Bhattacharya, Dr. Krishnananda Chattopadyay, Dr. Saikat Chakrabarti, Dr. Dipyaman Ganguly, Dr. Malini Sen, Dr. Subhajit Biswas

Neurodegenerative diseases: Causes and Corrections (miND)

Project Code: BSC 0115

Nodal Scientists: Dr. Subhas Biswas

Participating Institutes (only if IICB is the Nodal Lab): CCMB, IITR, CDRI, NCL, IICT

Participating Scientists from IICB: Dr. Debashish Bhattacharya, Dr. Biswadip Banerji, Dr. Suvendra Bhattacharya, Dr. Subhas Biswas, Dr. Krishnananda Chattopadhyay, Dr. Sumantra Das, Dr. Mrinal Ghosh, Dr. Ranjan Jana, Dr. Nakul Maiti, Dr. Ramalingam Natarajan, Dr. P. Jaisankar, Dr. Surajit Ghosh

Bio-energetic Disorders: A multi-model approach

Therapeutics of chronic obstructive pulmonary disease (COPD) and related respiratory disorders (TREAT)

Project Code: BSC 0116

Nodal Scientists: Dr. Arun Bandyopadhyay

Participating Institutes (only if IICB is the Nodal Lab): IGIB, IICT, IIIM, IITR, NEIST

Participating Scientists from IICB: Dr. Nahid Ali, Dr. Arun Bandyopadhyay, Dr. Saumen Datta, Dr. P. Jaisankar, Dr. Aditya Konar, Dr. Sib Sankar Roy, Dr. Malini Sen, Dr. Snehasikta Swarnakar

Title: Understanding and designing the supra molecular ensembles and machines (UNSEEN BSC0113)

Participating Laboratories: CSIR-IGIB, CSIR-CCMB, CSIR-CDRI, CSIR- IMT

Core Objective:

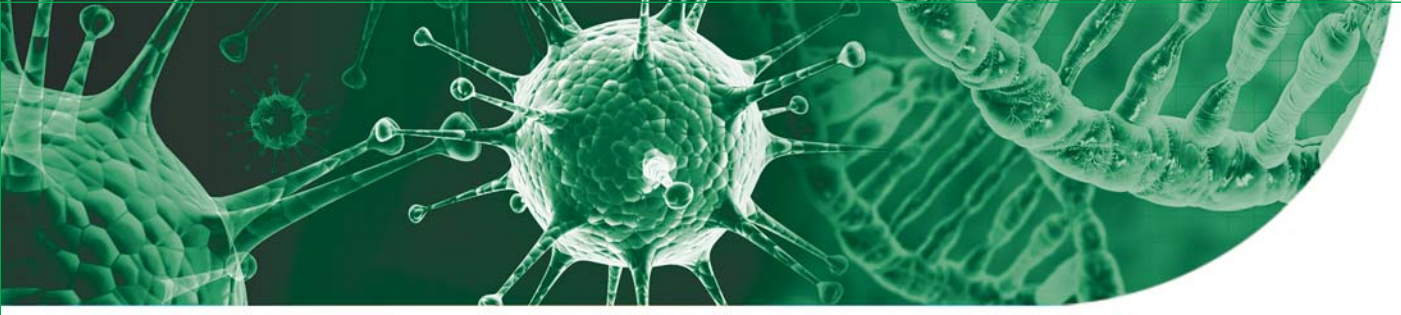
In living systems most proteins exist in large dynamic macro-molecular ensembles. To solve the structure and intrinsically complex dynamics of large bio-macromolecular complexes and machines (which are difficult to crystallize as such) using a 'Hybrid Approach'

Uniqueness and importance of core objective:

The proposed study is expected to greatly enhance our understanding of the structure and dynamics of several important biological assemblies and molecular motors involved in key cellular processes. To our knowledge, a structural biology project of this kind does not exist nationally. Additionally, many of the proposed studies have far reaching implications in human diseases. The proposed project would provide scientific information which would be useful to design therapeutic strategies.

Most Significant Milestones achieved towards attainment of the core objective

- 3D maps of some early oligomers of neurodegenerative disease-related proteins have been generated by Cryo-EM (~12Å)
- Cryo-EM was employed to generate 3D structures of transcriptional co- activator p300 in free and in complex with p53 (~12-15 Å)
- Cryo-EM maps were generated for ribosome biogenesis/stress response related GTPase HflX-bound to 50S and 30S ribosomal subunits *(E. coli)* (~9-10 Å)
- Crystallization of TSPYL1 protein, a member of NAP protein family, related to sudden infant death with dysgenesis of the testes syndrome
- Surface Chemistry has been developed to study reconstitution of in vitro microtubule organization for transport, and this chemistry already applied in other project to see their general applicability
- Synthesis of several lipopeptides for PSI encapsulations and stabilization has been done
- Cryo-EM data collected for a major T3SS translocator protein PopB (oligomer) from *Pseudomonas aeruginosa*
- Cryo-EM data collected for Serotonin G-protein coupled receptor (GPCR)
- Preliminary cryo-EM data got in collaboration with a group in Netherlands show that Rv3868 also can adopt multiple oligomers
- Structural and functional analysis of multi-domain proteins from *M. tuberculosis involved in complex lipid* synthesis
- Mechanism of proofreading enzymes involved in maintaining accuracy during translation of the genetic code is unveiled
- Detailed understanding on thrombolytic action of tPA by designing/altering its substrate specificity has been achieved
- The dynamics of *Vibrio cholerae* Pth (VcPth) enzyme and effects of mutants have been evaluated
- NMR Solution Structure of *M. Smegmatis* Pth has been determined
- Structural understanding of large biological complexes with significant implications in human health and diseases
- Enhancement of CSIR's ability to address structural biology of large molecular assemblies and their dynamic nature
- Establishment of structural biology hubs with sophisticated instrument facilities in strategic locations of the country
- Successful application of comparatively new structural biology techniques, particularly in context of Indian science,



(e.g cryo-EM, SAXS etc.) to determine structures of intrinsically dynamic macromolecular assemblies, helps to popularize these techniques in Indian scientific community

- Generation of employment and production of highly skilled PhD scientists and technicians, particularly in so far underused structural biology techniques
- Peer-reviewed publications and knowhow to build new concepts and their innovative applications
- Significant enhancement of national prestige and productivity in the international science community
- It is expected that at the completion of this project, a few observations could be translated into more product oriented efforts

Publications

- in prestigious Journal

Ahmad S., Routh S.B. et al. eLife (2013) 2:e01519

This study, for the first time, showed mechanism of a key 'chiral proofreading' process enforcing homochirality during translation

- Publications cited on the Journals cover (cover images)
- Publication, Paul S.S., Sil P., Haldar S., Mitra S., Chattopadhyay K., *J. Biol. Chem.* 2015 Jun 5:14476-90

Publications: 73

Patents Filed: 1

Trainees: 31

Phds: 15

Phd's Pursuing: 14

Title: Therapeutics of chronic obstructive pulmonary disease (COPD) and related respiratory disorders (TREAT BSC0116)

Participating Laboratories: CSIR-IGIB, CSIR-IITR, CSIR-IICT, CSIR-IIIM, CSIR-NEIST

Core Objective:

To explore New Targets for the treatment of Chronic Obstructive Pulmonary Disease (COPD) and Related Respiratory Disorder

Identification of target based new lead molecules of synthetic origin:

In effort to develop therapeutics of COPD, synthetic route for amenable for diverse library of compounds generation is optimized in the participating CSIR laboratory for the synthesis of elastase 2 inhibitor. Screening of 57 compounds against Elastase 2 activity is completed. Identified 5 compounds against Elastase 2. IC50 value is determined in the nanomolar range which is better than with existing molecules. Further activity was examined in cell culture system in which PD005 show significant inhibition of elastase 2 activity.

Combination therapy The combined administration with anti-inflammatory molecule, ICB-14-C/6 and phosphodiesterase inhibitor, ICT/TA/67 significantly improved lung function and reduced airway inflammation in mouse model of asthma.

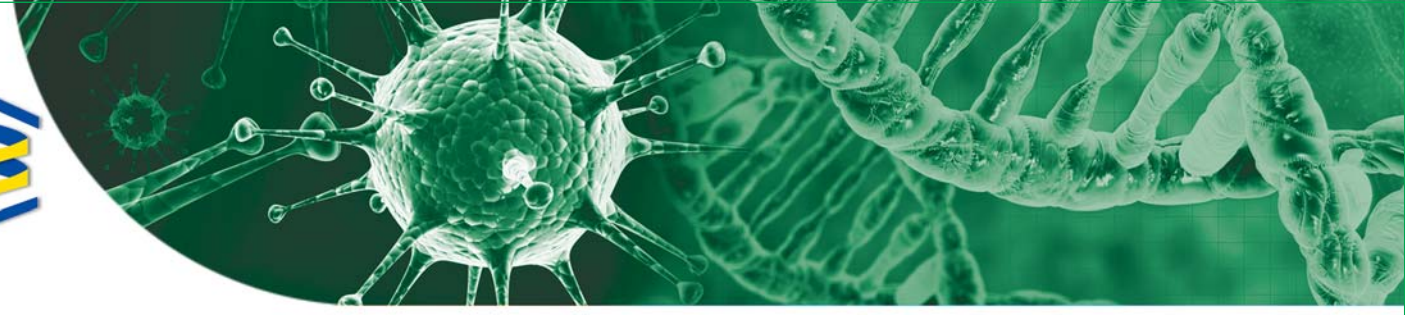
Publications:

20 (All networking laboratories combined)

Ph.D: 5

Title: Neurodegenerative disease: Causes and Corrections (miND)

Participating Laboratories: CSIR-CCMB, CSIR-IITR, CSIR-CDRI, CSIR-NCL, CSIR-IICT



Core Objective:

To address disease pathology by uncovering the non-canonical, emerging mechanism that governs neurodegeneration and to apply the knowledge for treatment.

Uniqueness and Importance of core objective: The study focused on investigation of unconventional emerging areas with a view to understand neurodegeneration, identify novel endogenous targets and develop new therapeutic measures employing appropriate disease models with a view to address disease progression, along with disease syndromes.

Milestones achievements during 2016-17:

- Revealed the transcriptional regulation of pro-apoptotic proteins Bim and Puma by FoxO3a and JNK/c-Jun during neuron death and identified them as potential targets for neuroprotection in AD & PD.
- Identified cell division cycle phosphatse 25A (CDC25A) and its target cyclin dependent kinase4 (CDK4) as required molecules for neuron death in response to trophic factor deprivation and to Aâ exposure and therefore as a potential target to suppress pathologic neuron death.
- Experimental methods using single molecule fluorescence and other spectroscopy have been developed to study the early events of the aggregation process.
- The structural and biochemical properties of tau, amyloid beta and alpha synuclein monomers and oligomers have been investigated in silico, in vitro and in neuronal cell lines.
- It is found that astrocytes secrete a number of beneficial molecules at early stages of Aβ exposure.
- Let-7a has been identified as the microRNA of interest, which is differentially regulated during neurodegeneration in AD and PD. KRAs are identified as let-7a targets.
- A detailed understanding of the RNA granules has been achieved using biochemical and microscopic techniques.
- A small library of molecules against CDK4 and CDC25A has been synthesized and their efficacy as potent neuroprotective agents against insult relevant to Alzheimer's disease is tested.
- A lead small molecule has been identified through rational design from a carefully designed and synthesized library of molecules. The lead showed excellent neuroprotection against Aβ-oligomer induced cell death.
- A series of multifunctional small molecular probes has been synthesized to control multiple pathogenesis of Alzheimer's disease. Lead molecules with strong neuro-protections have been identified.

Publications: 8

Patents: 1

HRD: 11 PhDs

Title: Host Interactome analysis: Understanding the Role of Host molecules in Parasitic Infection (HOPE)

Participating Labs: CSIR-CDRI,CSIR-CCMB, CSIR-IMTR, CSIR-NCL

Core Objective:

- To understand the inter-molecular host parasite interactions in the infection process of Leishmania for the development of new generation drugs.

Uniqueness and Importance of Core Objective:

- To address the mode of host-parasite interaction an interdisciplinary strategy involving both molecular and bio-informatic tools will be used the for development of new generation drugs.

Most significant milestones achieved

- Inhibitory action of Wnt5a on parasite infection is novel and has therapeutic potential.
- Liposomal cocktail vaccine formulation with three recombinant cysteine proteases [type I (CPB), II (CPA) and III (CPC)] conferred synergistic protection against of *L. donovani* infection in hamsters. Organ parasite burden by 10^{13} -10^{16} fold and survivality post 6 months infection was >80% in the liposomal cocktail group. CPC was the most potent among individual antigenic groups and identified as an alternative vaccine candidate for further studies.
- Aurora Kinase (AuK) identified as antileishmanial therapeutic target and a potential vaccine candidate.
- EF-1α and LACK were cloned and then evaluated as vaccine candidatess in murine model against *L. donovani* challenge. We show for the first time that EF1-α entrapped in cationic liposomes exhibit significant resistance to parasitic burden in both livers and spleens of BALB/c mice through induction of a robust DTH, IgG2a dominant antibody and Th1 biased cytokine responses.
- We have observed and delineated the mechanism of *Leishmania* induced changes in miRNA activity in infected macrophage and identified how the pathogen by altering mitochondrial membrane potential affect the miRNA level and activity in host cells.
- We have identified HuR as a ARE binding protein undoes changes in parasite infected cells. HuR found to get cleaved, the mechansim is not clear.

Publications: 9

PhD's: 5

Trainees: 9

Title: Bio-energetic Disorder: A multi-model approach to monitoring and management (BEnD)

Participating Laboratories:

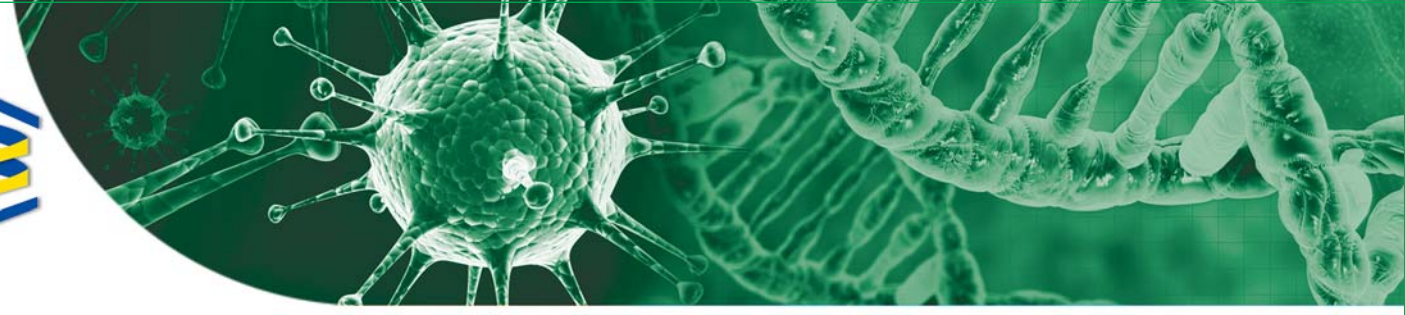
INTRA - INSTITUTIONAL

Core Objective and Uniqueness:

To understand the reduced bio-energy production and mitochondrial free radical generation through an array of disease models for the development of new generation drugs against mitochondrial diseases.

1. Most Significant Milestones achieved towards attainment of the core objective

- Identified novel method to correct mitochondrial dysfunction by protein- coding RNA .
- Synthesized tryptamine derivative (SEGA) to prevent gastric ulcer.
- Evaluated the role of PUMA in mitochondrial integrity and neuronal apoptosis in models of Alzheimer's disease (AD).
- Established a AD cybrid model to screen molecule against AD.
- Evaluated Carnitine palmitoyl transferase (CPT)-isoforms' ratio plays a major role diabetes type2, we showed. We have identified LRAT enzyme causing hepatic insulin resistance/steatosis and could be both biomarker as well as target for steatosis. Lastly TxNIP was identified as a factor responsible for ROS-induced Insulin resistance.
- Identified special roles of hypoxia and of micro RNAs in activation of satellite stem cells during muscle regeneration. In sketetal muscle, adipose triglyceride lipase (ATGL) constitute a regulatory pathway in aging muscle as a mitochondrial metabolic reserve.



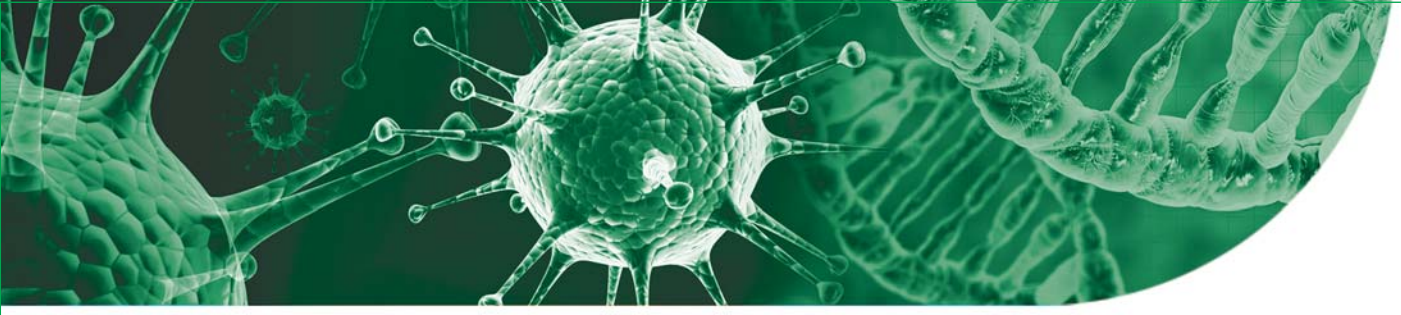
- We have discovered a new mechanism of alleviating fatty liver disease by mobilizing fat and enhancing mitochondrial fatty acid oxidation. Specifically we found that hepatic adipose triglyceride lipase (ATGL) is degraded by E3 ubiquitin ligase COP1 through ubiquitin-proteasomal pathway. Thus stabilization of hepatic adipose triglyceride lipase (ATGL) protein increases lipolysis, reduces lipid load and improves liver function in a mouse model of non-alcoholic fatty liver disease (NAFLD).
- miRNA28a is regulated by PPARá pathway and is critical in regulating mitochondrial dysfunction in hypertrophic cardiomyocytes. The regulatory role of annexin A6 in cardiomyocytes death and survival was established.
- A novel anti-inflammatory small molecule with benzoxazole scaffold was synthesized to manage inflammatory condition by blocking Toll Like Receptor 9 (TLR9) - mediated signaling pathway.
- Cox6b2 is a key gene in regulating mitochondrial metabolism and protecting pregnancy from IUGR, which affects a considerable proportion of Indian population leading to trans-generational malnutrition.

2. Number of Publications : 44

3.Number of Patents Filed: 4

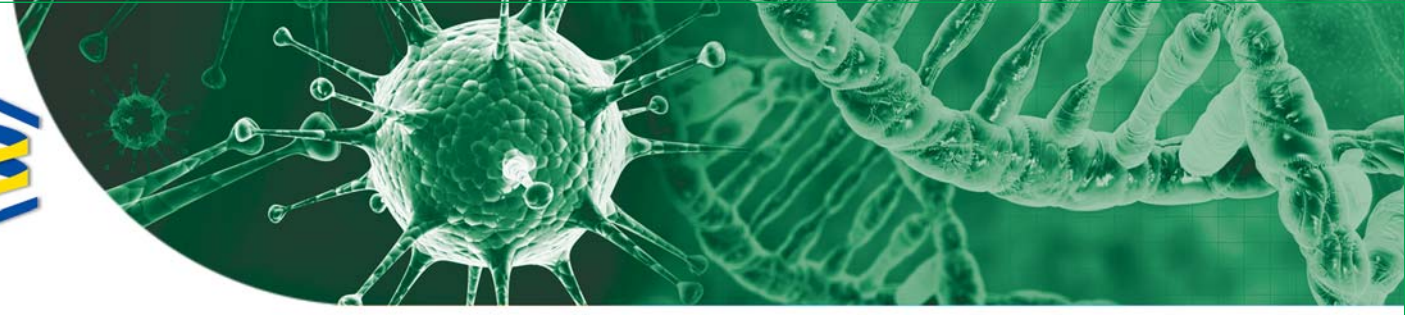
4.Number of Trainees: 50

5. Number of PhDs: 10



12th Five Year Plan Projects (IICB PARTICIPATING)

Sl. No.	Project Title (with Acronym)	Project Code	Nodal Lab	Co-Nodal Scientists	Participating Institutes (only if IICB is the Nodal Lab)	Participating Scientists from IICB
1.	Competent gamete production and reproductive dysfunction (PROGRAM) Sanc. Letter no: 31-2(230)/CDRI(2)/BSC 0101/2012-13/BUDGET	BSC 0101	CDRI	Dr. Rajender Singh	Dr. Gopal Gupta	Dr. Rupashri Ain, Dr. S.R. Dungdung, Dr. S.N. Kabir, Dr. Sib Sankar Roy
2.	Centre for biotherapeutic Molecule discovery (BIODISCOVERY) Sanc. Letter no: 31-2(230)/IMTECH(5)/BSC 0120/2012-13/BUDGET	BSC 0120	IMT	Dr. Girish Sahni	Dr. Ashish Ganguly	Dr. Nahid Ali, Dr. Sanjay Dutta, Dr. Syamal Roy, Prof. Siddhartha Roy, Dr. Susanta Roychoudhury, Dr. Malini Sen, Dr. Amitava Sengupta
3.	Genomics and informatics solutions for integrating biology (Genesis) Sanc. Letter No: 9/1/BS/IMTECH(6)/2012-13-PPD	BSC 0121	IMTECH	Dr. GPS Raghava	Not available	Dr. Saikat Chakraborty, Dr. Chitra Dutta, Dr. Nakul Maiti, Dr. Sucheta Tripathy
4.	Man as a superorganism: Understanding the human microbiome (HUM) Sanc. Letter no: 31-2(230)/IMTECH(2)/BSC 0119/2012-13/BUDGET	BSC 0119	IMTECH	Dr. Saumya Raychaudhuri	Dr. Ramya Chakrabarti	Dr. Rukhsana Chowdhury, Dr. Keya Chaudhury, Dr. Saikat Chakraborty, Dr. Chitra Dutta, Dr. Snehasikta Swarnakar
5.	Medicinal chemistry for stem cell biology and regenerative medicine (MEDCHEM) Sanc letter No: 31-2(230)/IIIM(2)/BSC 0108-2012-13-PPD	BSC 0108	IIIM	Dr. Sawant S.D.	Dr. Gandhi S.	Dr. Mrinal K. Ghosh
6.	Plant-Microbe and Soil Interactions (PMSI) Sanc. Letter no: 9/1/BS/BS/CCMB(4)/2012-13-PPD	BSC 0117	CCMB	Dr. Sonti Ramesh	Not available	Dr. Sharmila Chattopadyay , Dr. Samir Dutta
7.	Integrated nextgen approaches in health, disease and environtmental toxicity (Indepth) Sanc. Letter No: 9/1/BS/IITR(1)/2012-13-PPD	BSC 0111	IITR	Dr. Devendra Parmar	Dr. J.B. Panth	Dr. Arun Bandyopadhyay, Dr. Tarun Dhar , Dr. Snehasikta Swarnakar



Sl. No.	Project Title (with Acronym)	Project Code	Nodal Lab	Co-Nodal Scientists	Participating Institutes (only if IICB is the Nodal Lab)	Participating Scientists from IICB
8.	Genomics of medicinal plants & agronomically important traits (PlaGen) Sanc. Letter no: 9/1/BS/NBRI(2) /2012-13-PPD	BSC 0107	NBRI	Dr. Prabodh Trivedi	Not available	Dr. Sharmila Chattopadyay, Dr. Samir Dutta
9.	Development of noval CSIR technology for manufac-turing tailored and patent- specific bioceramic implants and biomedicinal devices at affordable cost (BIOCERAM) Sanc Letter No: 9/1/ES/ CGCRI(1) /2012-13- PPD	ESC 0103	CGCRI	Dr. R. Ravisankar	Not available	Dr. Partha Chattopadhyay, Dr. Surajit Ghosh, Dr. Aditya Konar, Dr. G. Suresh Kumar, Dr. Chitra Mandal, Dr. Amitava Sengupta
10.	Emerging and re-emerging challenges in infectious diseases: Systems based drug design for infectious diseases (SPlenDID) Sanc. Letter no: 31-2(230)/CDRI(5)/BSC 0104/2012-13/BUDGET	BSC 0104	CDRI	Dr. S. Chandrase-khar (IICT)	Not available	Dr. Uday Bandyopadhyay
11.	Organic reactions in generating innivative and natural scaffolds (ORIGIN) Sanc. Letter no: 9/1/CS/IICT(5)/2012-13-PPD	CSC 0108	IICT	Dr. Souvik Maiti (IGIB)	Not available	Dr. Biswadip Banerji, Dr. A. K. Banerjee, Dr. Partha Chattopadyay, Dr. Chinmay Chowdhury, Dr. Indrajit Das, Dr. P. Jaisankar, Dr. G. Suresh Kumar, Mandal N.B.
12.	Genome Dynamics in cellularorganization, differentiation and enatiostatis (GenCODE) Sanc. Letter no:9/1/BS/ IGIB(4)/2012-13-PPD	BSC 0123	IGIB	Not available	Not available	Dr. G. Suresh Kumar
13.	CSIR Knowledge gateway and open source private cloud infrastructure (KNOWGATE) Sanc. Letter No: 9/1/IS/NISCAIR(1)/2012-13-PPD	ISC 0102	CCMB	Dr. Rakesh Mishra	Not available	Dr. N.C. Ghosh
14.	Epigenetic in health and disease (EpiHeD) Sanc. Letter No: 9/1/BS/CCMB(5)/2012-13	BSC 0118		(CCMB)	Dr. Vinod Scaria (IGIB)	Dr. Arun Bandyopadhyay, Dr. Debabrata Biswas,

Publication & Information and Planning, Monitoring & Evaluation Division
Business Development Group and Patent Cell

Dr. G. Suresh Kumar (Head), Dr. Neeta V. M. Khalkho, Mr. Anil Kumar, Mr. Binayak Pal, Mr. Arupesh Majumder, Mrs. Purnima Chatterjee, Mr. Deepak Kumar Guin, Mr. Sankar Bhakta, Mr. Nishikanta Naskar, Mr. Pallab Mukherjee, Mr. Soumalya Sinha, Mr. Samir Thami and Mr. Bhaskar Basu

The scientific administration, supervision and thus management of different R&D activities of the institute are the primary foci of this division. The activities of this division are carried out by three major sections, e.g. [a] Publication & Information; [b] Business Development Group and Patent Cell [c] Planning, Monitoring & Evaluation. Therefore the success of this division mostly depends upon strong interrelation among these sections and excellent communication with R&D departments. Thorough interactions and proper attention in execution of the time-bound tasks facilitated successful management of this division. The details of the scientific management activities of the individual sections are given below separately for the reporting year.

Publication & Information Section

Dr. G. Suresh Kumar (Head), Dr. Neeta V. M. Khalkho (Incharge), Mr. Binayal Pal, Mr. Sankar Bhakta, Mr. Pallab Mukherjee and Mr. Nishikant Naskar

This section deals with diverse informational activities, publication and monitoring of reports and dissemination of information in electronic and printed forms. The major contribution of this section lies in assisting scientists in day to day maintenance of the institute activities and innovations, project profiles, publication records and research utilization data. The section was involved in the following wide spectrum of programmes during the report year.

Preparation of CSIR-IICB Annual Report.

Preparation of documents released during events.

Preparation of Annual Plan and Budget.

Dissemination of information to scientific milieu on relevant subjects.

Documentation of CSIR-IICB inputs for “CSIR Annual Report 2016-17” and “CSIR Research”.

Assistance to scientists, fellows and staff members for participation in seminars, symposia and conferences.

Maintenance of database for testing and calibration.

Assistance for record of the proceedings of Research Council meeting.

Preparation of a new up-to-date brochure for CSIR-IICB.

Updated information's regarding P&I section for CSIR-IICB website.

Public relations, advertisement and news and views forum.

Organization display of exhibition and science news dissemination.

Advice and comments for management of parliament queries whenever required.

Organization of 'OPEN HOUSE' and active help for 'LAB-VISIT' programmes.

Reply to Audit report regarding publication matters of the Institute.

Monthly Report of CSIR-IICB for PPD, CSIR.

Compilation of CSIR-IICB News for CSIR News Letter.

Preparation of Performance Indicator data for CSIR-IICB.

CSIR-IICB inputs for National survey of Biomedical laboratories and inventories sorting with.

Polio Virus material for Ministry of Health & family Welfare, GOI.

CSIR-IICB achievements for "CSIR Science Communication Forum".

CSIR-IICB inputs for CSIR Plan Projects through Slides.

Scientist Visit & Events

The P&I Section is also responsible for the announcement and arrangement of seminars for the national and international scientists who often visit the institute and like to share their research activities with CSIR-IICB faculties. About 33 numbers of Scientist visitors delivered their lecture during 2016-17. A total list of 'Scientific Seminars' is given in a separate page. The Institute also organized several significant events with the assistance of this section and 'List of Events' is also shown separately for the reporting year.

Management of Laboratory Visit for Students

On the occasion of CSIR Foundation Day celebration-2015, the members of this section have actively helped for the arrangement of 'OPEN HOUSE' programme where one hundred thirty three students eight schools/colleges/universities within and around Kolkata visited CSIR-IICB. A large number of students from different schools and colleges with their teachers visited various laboratories and interacted with the scientists expressing great interest and enthusiasm. Members of this section also arranged the laboratory visit for students of colleges and universities from outside Kolkata particularly from North East States. A total of (5) numbers of visits were organized throughout the year (2016-17). Lal Bahadur Shastri National Academy of Administrative (LBSNA), the pioneer training institute for civil servants has chosen CSIR-IICB, Kolkata for a Winter Study Visit organized for Officers Trainees 2016 batch. CSIR-IICB is welcomed a batch of 18 IAS Officers

Trainees on Tuesday, January 10, 2017 for Winter Study Tour "Bharat Darshan". India International Science Festival (IISF)

Cartain raiser, OUTREACH programme was organized by CSIR-IICB in Jaduvpur Campus on 23rd November, 2016 were 60 students from different colleges participated.

Art & Photography

Art Section has rendered full support to all the staff members during scientific seminars/symposia and all national events by preparing displays, illustrations, posters, exhibits, and slides. Diagrams, charts, graphs for publication in national and international journals are prepared in this section. They are working in collaboration with the Photography Section for making each exhibition a great success to highlight the institute's achievement. The section also participated in preparing artwork and cover design for Hindi Day and Hindi Report. This section has also carried out work for decoration of floor & institute during various scientific and official programmes. Seven Short Films on CSIR-IICB Technologies were made for technologies poster and leaflets were designed and printed in hindi. Photography Section has been successfully covering every event taking place in the institute. The section is continuously supplying all the photos for publications, Annual Reports, Journals and other related documents. Besides these they are also assisting the scientists of the institute. Apart from that they also handled photographs of scientific activities and experiment slides for publication in different international journals.

IAS Officers Trainees at CSIR-IICB on 10th January, 2017 for Winter Study Tour.

IISF OUTREACH Programme, November 23, 2016

Silchar University, visit on January 20, 2017

Tamralipta Mahavidyalaya Purba Medinipur College visit on March 10, 2017

Serampore College visit March27, 2017

Felicitation received by Team CSIR from Honorable Minister of State for Science & Technology, Y. S. Chowdhury on 14th August, 2016 at 20th National Science Exibition, Dumdum

Certificate and Shield Received by CSIR team in 20th National Science Exhibition

OPEN HOUSE 2016
Organizing Committee

College Students & CSIR-IICB Voulenteers in OPEN HOUSE, September 9, 2016

Mizoram University, 16 Students of M.Sc. Chemistry, January 24, 2017

Business Development Group (BDG) & Intellectual Property Management Cell

Dr. G. Suresh Kumar (Head), Mr. Anil Kumar (upto 06.04.2017), Dr. Aparna Laskar, Mr. Arupesh Majumdar, Mr. Dipak Kumar Guin and Mr. Bhaskar Basu

CSIR-IICB has excelled in both basic and applied research in chemical biology. Today, by its mandate, This institute is engaged primarily in research on diseases and certain biological problems of global interest. It is conducting basic research on infectious diseases, specifically leishmaniasis and cholera, along with the development of technologies for the diagnosis, immune-prophylaxis, and chemotherapy of various diseases. Over the past years, CSIR-IICB has generated various successful products.

CSIR-IICB is putting emphasis on quality basic research having applied potential and is looking forward to a successful Industry-Institute liaison towards closer partnership. The Business Development Group is the technology transfer arm of CSIR-IICB facilitating protection of institute's intellectual property and marketing inventions/know-how's generated.

The group facilitates to maintain strong relationships with the Industries in India and abroad with an aim to utilize the technologies and innovations arising out of the state of art research and development activities.

Vision

Dedicated to support and encourage the researchers, with an aim to turn science into commercial products for societal gain.

Goals & Objectives

- To protect, promote and market commercially promising inventions and know-how developed at CSIR-IICB.
- To scout for the "right fit" for each intellectual property available,
- To deliver, manage, and optimize knowledge transfer to domestic and global market through multiplicity of business development activities and services.

Major Activities of Business Development Group:

- Liason with industries and R&D institutions
- Licensing/Transfer of in house Technologies
- Utlization of Knowledge base / expertise developed in house
- Business and Partnership Negotiations
- Assistance for Technical Services
- Negotiation of Collaborative/Interdisciplinary Research, Agreements and MoUs

Intellectual Property Management Cell

Intellectual Property Management (IPM) cell in CSIR-IICB in close association with Business Development Group (BDG), CSIR-IICB and Innovation Protection Unit (IPU), CSIR is engaged throughout the year in different activities to protect intellectual property and achieve intellectual property rights for the scientific developments in CSIR-IICB. CSIR-IICB is developing its knowledgebase through world class science and innovation. The inventions having potential for commercialization are protected through patents and copyrights with an objective to put forward these technologies towards the benefit of common people in our country and abroad. With the help of a new Comprehensive Patent Database prepared by this cell, now brief information about a patent filed by CSIR-IICB, since 1990 is just a click away.

This cell has maintained liaison with Scientists of CSIR-IICB and IPU, CSIR to protect Intellectual Properties of CSIR-IICB/CSIR. During the reporting period, IPM Cell, CSIR-IICB provided all information, clarifications, explanations and reports to IPU, CSIR regarding new patent applications, granted patents and renewal or lapsing of existing patents in consultation with concerned inventors within the prescribed time-limit. A large number of correspondences were made with IPU, CSIR, a significant number of responses were conveyed on patent applications in India and abroad interacting with CSIR-IICB scientists and inventors regarding patent queries to provide necessary information to obtain productive results. The IPM Cell always extended co-operation to the inventors, CSIR-IICB in writing and filing patent applications. This cell has prepared, maintained and disseminated all information regarding patent application, status of the application, renewal etc. as and when it was required. IPM cell, CSIR-IICB has provided all necessary information to Business Development Group and Project Monitoring & Evaluation Division of CSIR-IICB for technologies developed; patents filed and granted; sent information on patent and technology to IPU, CSIR regarding Audit and Parliamentary Question; prepared year wise documents on total Patents of CSIR-IICB filed and granted.

Some of the significant works done are as follows:

1. Reviewing renewal and lapse of Indian and Foreign patents in force and recommendations prepared for each patent sent to IPU, CSIR.
2. Commercial Working Report for 10 Indian Patents of CSIR-IICB prepared and sent to IPU, CSIR.
3. Response to IPU, CSIR regarding IPER, IPRP, OA, Designated Countries and other queries relating to patent applications and filing.
4. Year wise documents prepared on total Patents of CSIR-IICB filed and granted.
5. Information on patent and technology transfer to IPU, CSIR regarding Audit and Parliamentary Questions.
6. Maintenance of CSIR-IICB Patent Database to keep it up-to-date

During reporting period, the performance at a glance of IPM Cell is as follows:

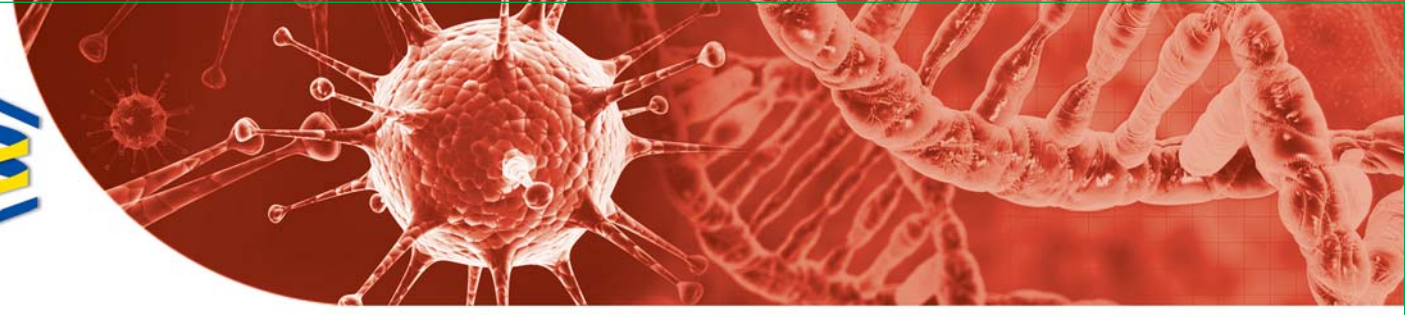
Patents Filed:

Indian Patents Filed

Complete Filed:	…	1
Provisionally Filed:	…	2
International Patents Filed	…	1

Patents Granted:

I*nternational Patents Granted*	…	5



Patents Filed in India

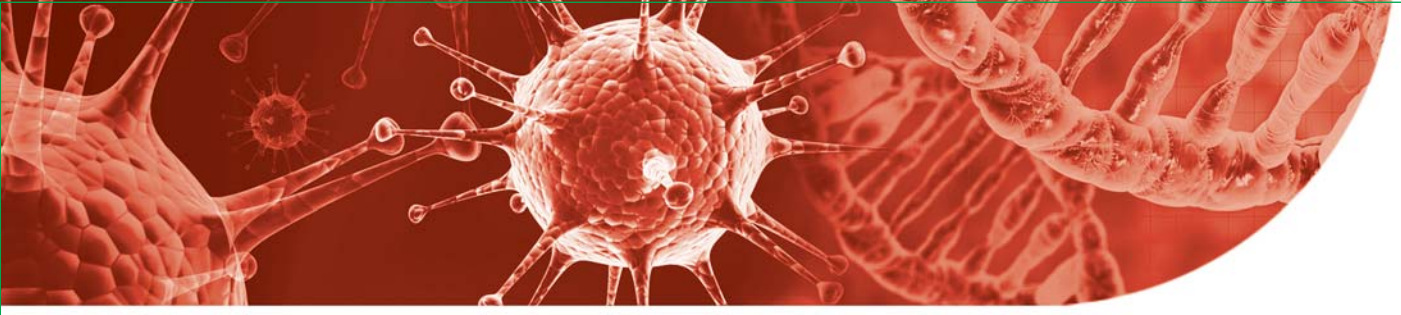
Sl. No.	Title	Inventors	Comp. Filing Date
1.	Blocking Toll-like Receptor 9 Signaling With Small Molecule Antagonist	Arindam Talukdar, Dipyaman Ganguly, Barnali Paul, Ayan Mukherjee, Shounak Roy, Swarnali Roy, Amrit Raj Ghosh, Roopkatha Bhattacharya, Oindrila Rahaman, Biswajit Kundu	20/Mar/2017

Provisionally Filed in India

Sl. No.	Title	Inventors	Prov. Filing Date
1.	A liposomal composition of Photo System-I for treatment of cancer	Surajit Ghosh, Abhijit Saha, Subhajit Ghosh, Saswat Mohapatra, Batakrishna Jana, Debmalya Bhunia	05/Oct/2016
2.	3-Indolyl furanoids as inhibitors of matrix metalloproteinase-9 for prevention of gastric ulcer and other inflammatory diseases	Parasuraman Jaisankar, Snehasikta Swarnakar, Sourav Chatterjee, Sugreev Verma, Madhumita Mandal, Susri Ray Chaudhuri	15/Feb/2017

Filed Abroad

Sl. No.	Title	Inventors	Country	Comp. Filing Date
1.	Blocking Toll-like Receptor 9 Signaling With Small Molecule Antagonist	Arindam Talukdar, Dipyaman Ganguly, Barnali Paul, Ayan Mukherjee, Shounak Roy, Swarnali Roy, Amrit Raj Ghosh, Roopkatha Bhattacharya, Oindrila Rahaman, Biswajit Kundu	World	21/Mar/2017



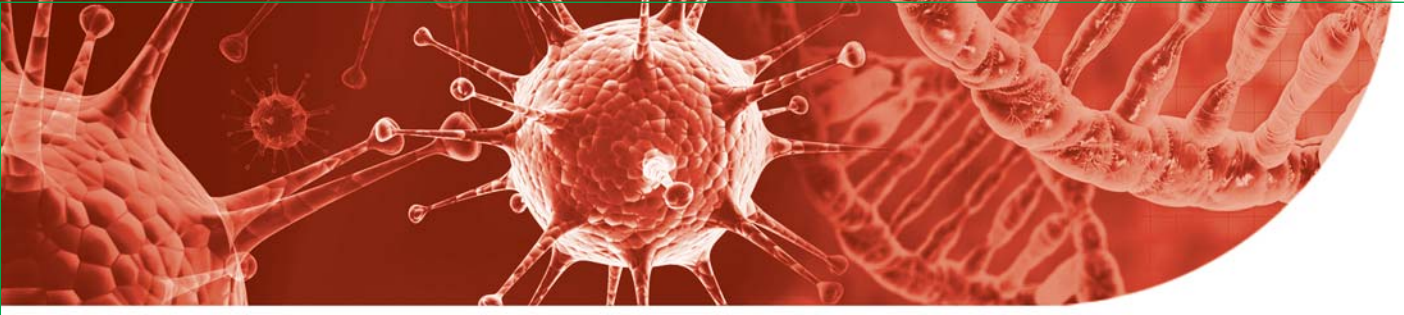
Granted Abroad

Sl. No.	Title	Inventors	Country	Grant Date	Patent No.
1.	Inhibitors of IL-4 and IL-5 for the treatment of bronchial asthma	Santu Bandyopadhyay, Balaram Ghosh, Parasuraman Jaisankar, Bikas Chandra Pal, Siddhartha Roy, Bholanath Paul, Arjun Ram, Ulaganathan Mabalirajan, Nahid Ali, Arun Bandyopadhyay, Aditya Konar, Jayashree Bagchi Chakrabotry, Indrani Chaudhury Mukherjee, Jaydeep Chaudhuri, Sanjit Kumar Mahato, Anirban Manna, Roma Sinha, Pradyot Bhattacharya, Jayaraman Vinayagam, Deba Prasad Jana, Sushovan Chowdhury	USA	05/Apr/2016	9,302,967
2.	Methanolic extract of piper betel leaves for the treatment of human malignancies by inducing oxidative stress	Santu Bandyopadhyay, Bikas Chandra Pal, Jayashree Bagchi Chakraborty, Srabanti Rakshit, Labanya Mandal, Kausik Paul, Nabendu Biswas, Anirban Manna,	Europe [Germany, Great Britain, France]	27/Jul/2016	2224938
3.	Compositions and methods for delivery of protein-coding rnas to correct mitochondrial dysfunction	Samit Adhya	Europe [Germany, Great Britain, France]	27/Jul/2016	2329023
4	A synthetic peptide formulation against melanoma and other cancers over-expressing S100B	Amlanjyoti Dhar, Shampa Mallick, Israr Ahmed, Aditya Konar, Santu Bandyopadhyay, Siddhartha Roy	USA	09/Aug/2016	9408888
5.	A synthetic peptide formulation against melanoma and other cancers over-expressing S100B	Amlanjyoti Dhar, Shampa Mallick, Israr Ahmed, Aditya Konar, Santu Bandyopadhyay, Siddhartha Roy	Europe [Great Britain, France]	30/Nov/2016	2670416

Planning Monitoring & Evaluation Section

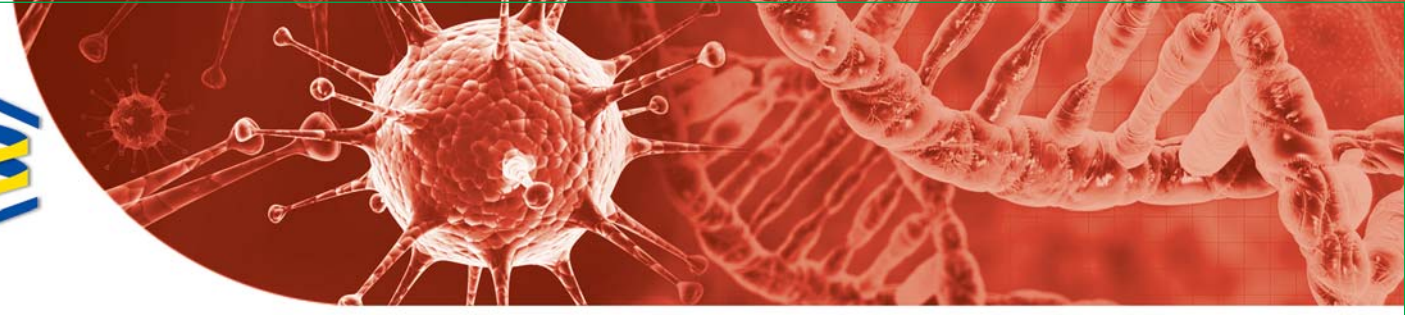
Dr. G. Suresh Kumar (Head), Mrs. Purnima Chatterjee, Mr. Soumalya Sinha, Mr. Samir Thami and Mr. Sukhendu Biswas

The planning, monitoring and evaluation(PME) section fromed in August, 2009 effectively manages the Institute's plan and non-plan projects, grant-in aid, sponsored and collaborative R&D projects. The Division maintains liaison with Principal Investigators-Finance section-Purchase section and the grant giving agencies. PME provides proper logistic support for the management, maintenance and monitoring of CSIR funded projects and externally funded projects. PME helps in effective and successful implementation of the institute's commitments to all R & D acts. PME is also entrusted with appropriate dissemination of information regarding ongoing and completed projects. PME of CSIR-IICB like other CSIR laboratories is actively involved in the preparation and timely maintenance of databases for all intramural and extramural research projects, project expenditure monitoring of all projects, monitoring ECF of the Institute, preparation of responses to Parliamentary questions in relation to the activities of the Institute, dissemination of information on all relevant National & International research program requests, including fellowships and maintenance of mandatory registration with such agencies, and liaison, PME awareness to scientists regarding terms & conditions of funding agencies, responding to various audit queries in relation to both ongoing and completed projects, participation in Institute's annual plan, budget preparation expenditure status, monitoring the receipts of cheques as well as online transfer of fund by the sponsors against the project granted, and request for such fund, and proper record keeping of the projects, regular interactions with finance division regarding the expenditure carried out against the projects in a monthly basis and recorded in the concerned project, and obtaining approval of projects for submission to external funding agencies from competent authorities (RC, Director, MC, etc.) Details of extramural project activities (sanctioned, currently progressing and compared) are provided in a separate page as 'External Funding'.



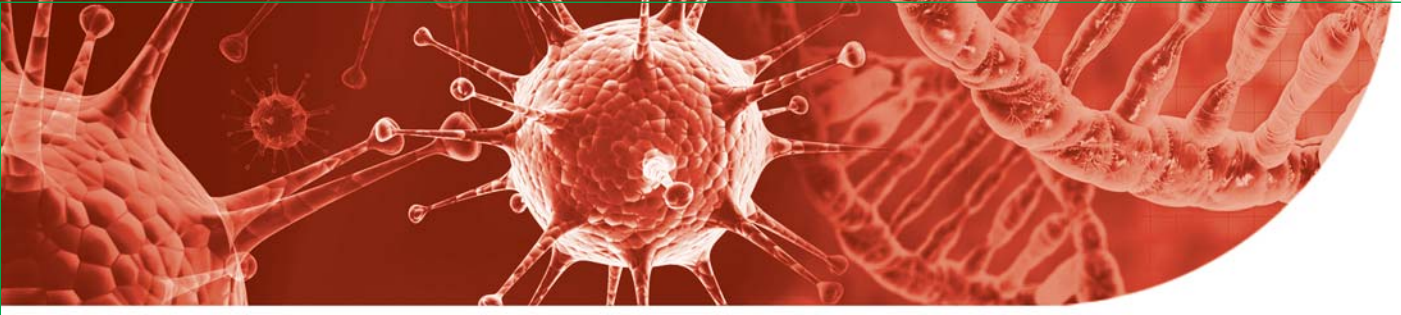
Externally Funded Projects Completed During 2016-17

Sl. No.	Principal Investigator	Project Title	Sanction Order No.	Project Code No.	Funding Agency
1.	Dr. Rupasri Ain	Studies on trophoblast and natural killer cell interaction at the maternal-fetal interface	SB/SO/AS-114/2012	GAP - 301	SERB, DST
2.	Dr. Sharmila Chattopadhyay	Cross-talk of glutathione with other signaling molecules to combat biotic stress in planta	SERB/SR/SO/PS/07/2012	GAP - 302	SERB, DST
3.	Dr. Malini Sen	Role of Wnt5a signaling in the initiation and progression of sepsis	BT/PR7106/MED/29/639/2012	GAP - 304	DBT
4.	Dr. Mita Chatterjee Debnath	Evaluation of the therapeutic efficacy of liposomal and nanoparticulated flavonoids in combating oxidative hepatocellular degeneration by nuclear imaging technology using Tc-99m radiopharmaceuticals	2013/35/25/BRNS	GAP - 305	BRNS, DAE
5.	Dr. Subrata Adak	Examine mechanism of electron transfer leishmania major (LmAPX) by site directed mutagenesis	BT/HRD/NBA/34/01/2012(iv)	GAP - 306	DBT
6.	Dr. Partha Chakraborti	Octreotide derivative modified lipid nanoparticles : preparation, radiolabeling & applications a tumor radiopharmaceuticals	2013/35/44/BRNS	GAP - 307	BRNS, DAE
7.	Dr. Krishnananda Chattopadhyay	Experimental and computational study of the aggregation pathway of alpha synuclein	SB/YS/LS-	GAP - 308	SERB, DST
8.	Dr. Indrajit Das	N-heterocyclic carbene catalyzed diastereoselective synthesis of substituted cyclohexanones from modified carbohydrates: application to the total synthesis of conduramines and phenanthridone alkaloids	65/2013 SB/FT/CS-105/2012	GAP - 310	SERB, DST
9.	Dr. Partha Chakraborti	Insulin and nutrient mediated regulation of adipocyte metabolism	SB/SO/HS/0064/2013	GAP - 311	DST
10.	Dr. Sucheta Tripathy	Whole genome and transcriptome sequencing of selected indian cyanobacterial species for candidate gene discovery for bio-metabolites	NBAIM/AMAAS/2014-15	GAP - 315	ICAR
11.	Dr. Rupasri Ain	Transgenic over-expression of nosip in mice and pregnancy - induced hypertension	BT/PR9113/MED/97/134/2014	GAP - 316	DBT
12.	Dr. P. Jaisankar	Identification of eight obligately halophilic cyanobacteria of the Sundarbans and molecular characterization of antimicrobial compounds therefrom	MoES-2/DS/6/2007 PC-IV	GAP - 318	Ministry of Earth Sciences, Govt. of India



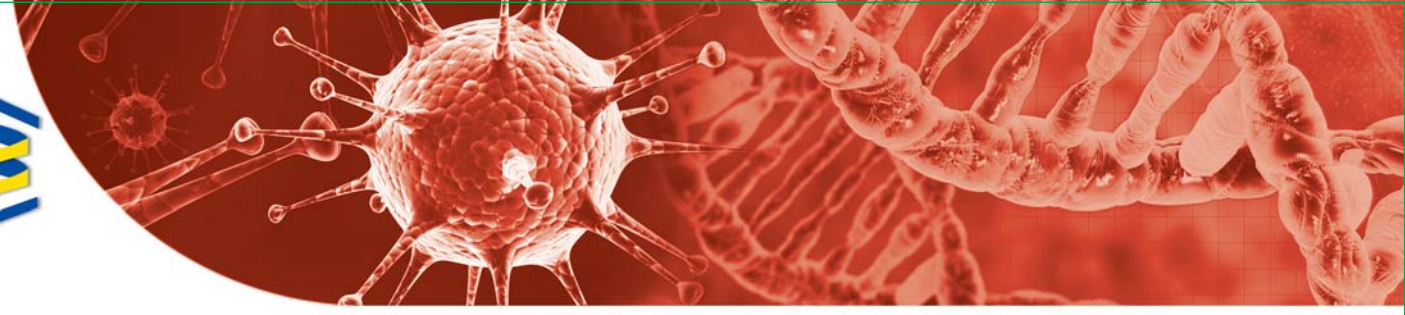
Externally Funded Projects Ongoing During 2016-17

Sl. No.	Principal Investigator	Project Title	Sanction Order No.	Project Code No.	Funding Agency
1.	Dr. Krishna Das Saha	Mechanistic study of effect of spergulin-A extracted from glinus oppositifolious on macrophages to raise anti leishmanial host defense.	EMR/2015/001674	GAP-335	DST, Govt.of India
2.	Dr. Pijush K. Das CoPI- Dr. R. K. Bhadra	Targeting deadenlation-mediated kinetoplastidae prasite-specific polycistronic gene regulation for therapeutic intervention	BT/PR10289/BRB/10/1257/2013	GAP-337	DBT, Govt. Of India
3.	Dr. S. N. Bhattacharyya	Role of inter and subcelluar miRNA trafficking in controlling lipid metabolism in mammalian liver cells, Swarnajayanti fellowship	DST/SJF/LSA-03/2014-15	GAP-341	DST, Govt. Of India
4.	Dr. Sucheta Tripathy	Assessing the genome sequences of termitomyces clypeatus for novel metabolite discovery through whole genome sequencing method and characterization of the metabolites for application in biotechnology	BT/PR9481/NDB/39/394/2013	GAP-342	DBT, Govt. of India
5.	Dr. Rupasri Ain	MiRNAs in trophoblast stem cell differentiation	EMR/2015/001195	GAP-343	SERB, DST, Govt. of India
6.	Dr. Surajit Ghosh	Development of anti-alzheimer peptide from taxol binding pocket of B-tubulin	EMR/2015/002230	GAP-344	SERB, Govt. Of India
7.	Dr. Dipyaman Ganguly	Role or type I interferons in cerebral malaria	BT/PR10665/MED/29/828/2014	GAP - 345	DBT, Govt. of India
8.	Dr. Chitra Mandal CoPI- Dr. Saikat Chakrabarti, Dr. Chhabinath Mandal	Role of sialylated glycan on pseudomonas aeruginosa in interactuion with innate immune cells: a glyco-proteomics approach	BT/PR13012/MED/29/919/2015	GAP - 346	DBT, Govt. of India
9.	Dr. S. N. Bhattacharya	Host Interactome analysis: understanding the role of host molecules in parasitic Infection (HOPE) Indo-Belgian research proposal: support of networking activities	DST/INT/BEG/P-1/2014	GAP - 347	Belgian Federal Science Policy Office (BELSPO) & DST
10.	Dr. Partha Chakrabarti	A prosperative study on the role of incertin hormones in patients undergoing bariatric surgery	578 (Sanc) /BT (Estt) / RD 16/2015	GAP - 348	DBT, Govt. Of West Bengal



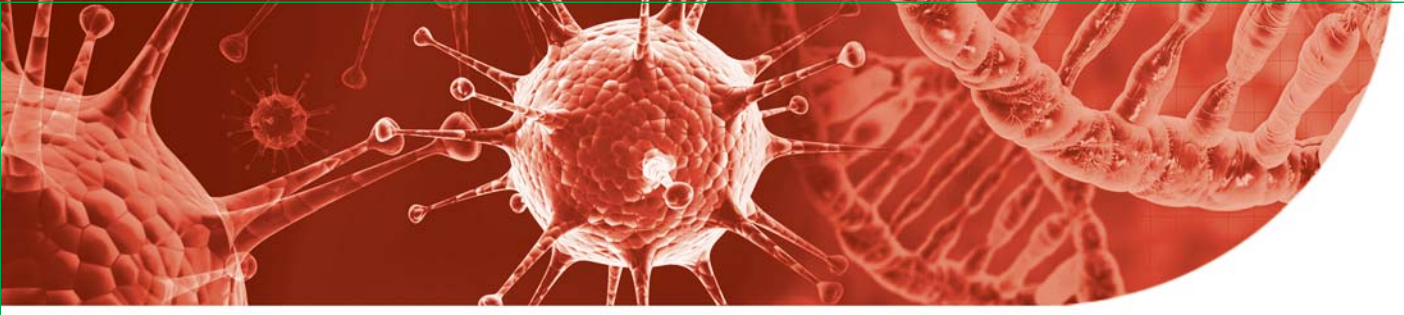
Externally Funded Projects Ongoing During 2016-17

Sl. No.	Principal Investigator	Project Title	Sanction Order No.	Project Code No.	Funding Agency
11.	Dr. Partha Chakrabarti	Stereoselective total synthesis of marine macrocyclic lactone biseyngbyaside and its variants and their biological activities	EMR/2016/000 988	GAP-353	SERB DST,Govt. of India
12.	Dr. P. Jaisankar	Development of axially chiral 3-indolyl based heterobiaryls:synthesis,separation,isolation of atropisomers and study of their physicochemical properties,applications in biology and materials science	EEQ/2016/000 605	GAP-355	SERB, GOVT. Of India
13.	Dr. Krishna Das Saha	Utilization of pomegranate for development of functional medicinal ingredients	Z.18017/187/C SS/R&D/MH-02/2016-17NMPB-IVA	GAP-356	AYUSH,Go vt. Of India
14.	Dr. Samit Chattapadhyay	Multi dimensional research to enable systems medicine : acceleration using a cluster approach	BT/Med-II/NIBMG/SyMe C/2014/Vol.II	GAP-357	DBT, Govt.of India
15.	Dr. Indrajit Das	á- Ketothioesters : An indispensable building blocks for accessing diverse heterocycles via sulfanyl anions or thiyl radical migration	EMR/2016/001 720	GAP-359	SERB
16.	Dr. Sib Sankar Roy	Mechanism of Ets-1 transcription factor- mediated metabolic reprogramming and tumorigenesis in ovarian cancer	EMR/2016/002 578	GAP-360	SERB
17.	Dr. S. N. Bhattacharyya	Characterization of exosomes released by macrophages infected with leishmania donovani	BT/HRD/NBA/3 7/01/2015(iii)	GAP-361	DBT
18.	Dr. S. N. Bhattacharyya	Compartmentalization of micro RNA-dependent post-transcriptional processes in mammalian cells: role of sub-cellular structures and organelles	HRR/2016/000 093	GAP-362	SERB
19.	Dr. Partha Chakrabarti	Elucidation of roles of inflammatory mediators in pancreatic cell and hepatocyte dysfunction type 2 diabetes	5/4/5-9/Diab-16-NCD-II	GAP-363	ICMR
20.	Dr. Sujoy Mukherjee	Transiently formed non-native conformers of transthyretin: structure, function and their roles in formation of amyloid fibrils -[ ]	BT/PR15017/B RB/10/1445	GAP-365	DBT



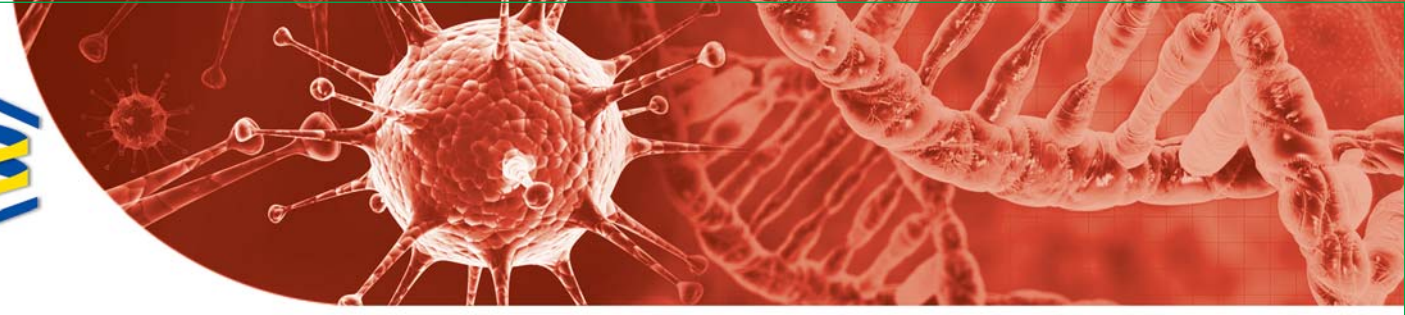
Sanctioned and Implemented Projects During 2016-17

Sl. No.	Principal Investigator	Project Title	Sanction Order No.	Project Code No	Funding Agency
1.	Dr. Krishna Das Saha	Mechanistic study of effect of Spergulin-A extracted from Glinus oppositifolious on macrophages to raise anti leishmanial host defense	EMR/2015/001 674	GAP-335	DST,Govt.of India
2.	Dr. P. K. Das CoPI- Dr. R. K. Bhadra	Targeting deadenlation-mediated kinetoplastidae prasite-specific polycistronic gene regulation for therapeutic intervention	BT/PR10289/B RB/10/1257/20 13	GAP-337	DBT, Govt. Of India
3.	Dr. S. N. Bhattacharyya	Role of inter and subcelluar miRNA trafficking in controlling lipid metabolism in mammalian liver cells, Swarnajayanti Fellowship	DST/ SJF/LSA-03/2014-15 BT/	GAP-341	DST, Govt Of India
4.	Dr. Sucheta Tripathy	Assessing the genome sequences of Termitomyces clypeatus for novel metabolite discovery through whole genome sequencing method and characterization of the metabolites for application in biotechnology	PR9481/NDB/3 9/394/2013	GAP-342	DBT, Govt of India
5.	Dr. Rupasri Ain	miRNAs in trophoblast stem cell differentiation	EMR/2015/0011 95	GAP-343	SERB, DST, Govt. of India
6.	Dr. Surajit Ghosh	Development of anti-alzheimer peptide from taxol binding pocket of B-tubulin	EMR/2015/002 230	GAP-344	SERB, Govt. Of India
7.	Dr. Dipyaman Ganguly	Role or type I interferons in cerebral malaria	BT/PR10665/M ED/29/828/2014	GAP - 345	DBT, Govt. of India
8.	Prof. Chitra Mandal CoPI- Dr. Saikat Chakrabarti, Dr. Chhabinath Mandal	Role of sialylated glycan on pseudomonas aeruginosa in interactuion with innate immune cells: a glyco-proteomics approach	BT/PR13012/M ED/29/919/2015	GAP - 346	DBT, Govt. of India
9.	Dr. S. N. Bhattacharyya	Host Interactome analysis: understanding the role of host molecules in parasitic Infection (HOPE) Indo-Belgian research proposal: support of networking activities	DST/INT/BEG/P-1/2014	GAP - 347	Belgian Federal Science Policy Office (BELSPO) & DST
10.	Dr. Partha Chakrabarti	A prosperative study on the role of incertin hormones in patients undergoing bariatric surgery	578 (Sanc) /BT (Estt) / RD 16/2015	GAP - 348	DBT, Govt. Of West Bengal
11.	Dr. Krishnanda Chattopadhyay	Investigation of the folding and aggregation landscape of superoxide dismutase invitro and in live cells : its implication in amyotrophic lateral sclerosis (ALS)	EMR/2016/000 310	GAP-349	DBT,Govt. Of India
12.	Dr. Subhajit Biswas	Molecular epidemiology and characterization of occult hepatitis B virus (HBV) infectious, particularly the role of S protein mutations leading toundetectable HBV surface antigen (HBsAg) in patient blood plasma	ECR/2016/0000 32	GAP-350	SERB



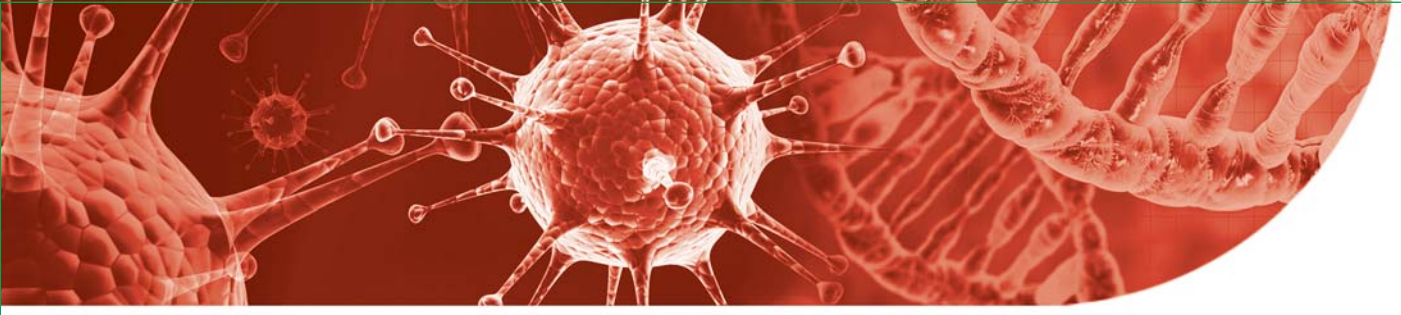
Sanctioned and Implemented Projects During 2016-17

Sl. No.	Principal Investigator	Project Title	Sanction Order No.	Project Code No.	Funding Agency
13.	Dr. Samit Chattapadhyay	Tumor suppressor SMART regulates transcription of Beta-catenin and protect from metastatic colon cancer	EMR/2015/001111	GAP-351	SERB
14.	Dr. Krishna Das Saha	Designing bioactive peptides from whey liquid waste of the dairy industry: functionallyand health benifit in obesity, obesity associated disorders with exploration of molecular mechanism	BCIL/NER-BPMC/2016	GAP-352	DBT
15.	Dr. Partha Chakrabarti	Stereoselective total synthesis of marine macrocyclic lactone biseyngbyaside and its variants and their biological activities	EMR/2016/000988	GAP-353	SERB DST,Govt. of India
16.	Dr. P. Jaisankar	Development of axially chiral 3-indolyl based heterobiaryls:synthesis,separation,isolation of atropisomers and study of their physicochemical properties,applications in biology and materials science	EEQ/2016/000605	GAP-355	SERB, GOVT. Of India
17.	Dr. Krishna Das Saha	Utilization of pomegranate for development of functional medicinal ingredients	Z.18017/187/CSS/R&D/MH-02/2016-17NMPB-IVA	GAP-356	AYUSH, Govt. Of India
18.	Dr. Samit Chattapadhyay	Multi dimensional research to enable systems medicine : acceleration using a clusterapproach	BT/Med-II/NIBMG/SyMeC/2014/Vol.II	GAP-357	DBT, Govt.of India
19.	Dr. Indrajit Das	A - ketothioesters : an indispensable building blocks for accessing diverse heterocycles via sulfanyl anions or thiyl radical migration	EMR/2016/001720	GAP-359	SERB
20.	Dr. Sib Sankar Roy	Mechanism of Ets-1 transcription factor- mediated metabolic reprogramming and tumorigenesis in ovarian cancer	EMR/2016/002578	GAP-360	SERB
21.	Dr. S. N. Bhattacharyya	Characterization of exosomes released by macrophages infected with leishmania donovani	BT/HRD/NBA/37/01/2015(iii)	GAP-361	DBT
22.	Dr. S. N. Bhattacharyya	Compartmentalization of micro RNA-dependent post-transcriptional processes in mammalian cells: role of sub-cellular structures and organelles	HRR/2016/000093	GAP-362	SERB
23.	Dr. Partha Chakrabarti	Elucidation of roles of inflammatory mediators in pancreatic cell and hepatocyte dysfunction type 2 diabetes	5/4/5-9/Diab-16-NCD-II	GAP-363	ICMR
24.	Dr. Sujoy Mukherjee	Transiently formed non-native conformers of transthyretin: structure, function and their roles in formation of amyloid fibrils -[ ]	BT/PR15017/BRB/10/1445	GAP-365	DBT



DEPUTATION ABROAD

Name of Scientist	Designation & Division	From	To	Country	Conference/Symposium/Workshop attended
Dr. Arun Bandyoadhyay	Sr. Principal Sct., Cell Biology & Physiology Division	25.04.2016	29.04.2016	Germany	To participate in the forthcoming edition of Hannover Messe, as a part of India Technology Pavilion to be held at Hannover
Dr. Sucheta Tripathy	Principal Sct., Structural Biology & Bioinformatics Division	14.06.2016	17.06.2016	Sweden	For oral presentation in Oomycetes Molecular Genetics Network 2016 at Malmo
Dr. Suvendra Nath Bhattacharyya	Principal Sct., Molecular Genetics Division	30.09.2016	13.10.2016	France	A scientific presentation in an international EMBO/EMBL at Heidelberg and to visit Cure Instt., Paris
Dr. Dipyaman Ganguly	Senior Sct., Cancer Biology & Inflammatory Disorder Division	14.10.2016	18.10.2016	China	For an oral presentation in the 14th International Symposium on Dendritic Cells held at Shanghai
Mr. Anil Kumar	Scientist, Bussiness Development Group	24.10.2016	28.10.2016	China	To attend WIPO/SIPO Training Course on Management and Commerialization of IP Assets a China
Dr. Surajit Ghosh	Senior Sct., Organic & Medicinal Chemistry Division	12.12.2016	13.12.2016	Japan	For attending an international symposium at Osaka
Dr. Suvendra Nath Bhattacharyya	Principal Sct., Molecular Genetics Division	12.12.2016	16.12.2016	China	For attending a Cold Spring Harbor Asia Conference on Biology & Function of Extracellular Vesicles : Exosomes, Microvesicles & Beyond
Dr. Amitava Sengupta	Senior Sct., Cancer Biology & Inflammatory Disorder Division	31.01.2017	04.02.2017	Canada	For a poster presentation in Keystone Symposium on Hematopoiesis, Banff, Alberta
Dr. Rupak K. Bhadra	Chief Sct., Infectious Diseases & Immunology Division	07.02.2017	10.02.2017	South Korea	For attending the “United States-Japan Cooperative Medical Science Program’s 19th International Conference on Emerging Infectious Diseases in the Pacific Rim (EID)”

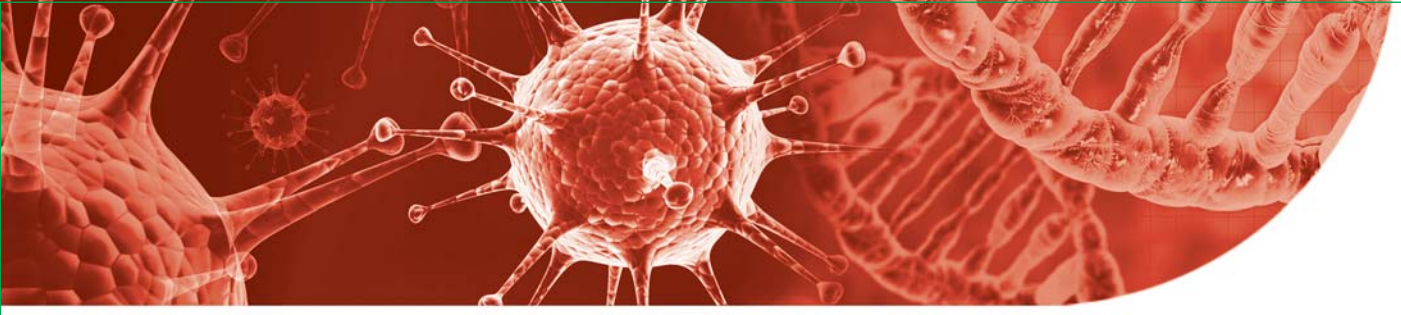


COLLOQUIUM APRIL 2016 to MARCH 2017

1.	Speaker	Dr. Ranjan Sen, Staff Scientist, Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad.
	Title	" Rho-dependent transcription termination in bacteria: from mechanism to physiology".
	Date	3rd March, 2016 at 4 PM, Dr. J. C. Ray Auditorium
2.	Speaker	Dr. Nahid Ali, Chief Scientist, CSIR-IICB, Kolkata .
	Title	“Three decades and more: A beautiful journey through trials, tribulations and triumphs”
	Date	21st July, 2016 at 4 PM, Dr. J. C. Ray Auditorium
3.	Speaker	Dr. Arun Bandyopadhyay, Sr. Principal Scientist, CSIR-IICB, Kolkata
	Title	“Understanding Cardiovascular disease: Clinical Implications”
	Date	9th August, 2016, at 4 PM
4.	Speaker	Dr. Sibsankar Roy, Senior Principal Scientist of Cell Biology and Physiology Division of CSIR-IICB.
	Title	“Metabolic Disorders: Challenges and Future Strategies”
	Date	1st September, 2016 at 4 PM
5.	Speaker	Dr. Chitra Dutta, Chief Scientist and Head of Structural Biology and Bioinformatics Division of CSIR-IICB.
	Title	“THE MICROBIAL WORLD: A VIRTUAL TOUR”
	Date	27th October, 2016 at 4 PM, Dr. J. C. Ray Auditorium]
6.	Speaker	Dr. Suvendra Nath Bhattacharyya, Swarnajayanti Fellow, DST, Govt. of India, Principal Scientist and Head, Molecular Genetics Division, CSIR-IICB.
	Title	“Complex Life of microRNAs: Mighty Regulation of a Tiny RNA”
	Date	3rd November, 2016 at 3:30 PM, Dr. J. C. Ray Auditorium
7.	Speaker	Dr. Rukhsana Chowdhury, Chief Scientist, CSIR-IICB
	Title	“Journey to the centre of the ‘gut’: Response of Gastrointestinal pathogens to milestones along the way ”
	Date	10th November, 2016 at 4 PM, Dr. J. C. Ray Auditorium
8.	Speaker	Dr. Snehasikta Swarnakar, Senior Principal Scientist and Head of Cancer Biology and Inflammatory Disorder, Division, CSIR IICB
	Title	“Walking through a tricky trail of metalloproteases: Landscape in disease dynamics”.
	Date	19th January, 2017
9.	Speaker	Dr. Biswadip Banerjee, Principal Scientist of OMC, CSIR IICB
	Title	“Design & Synthesis of some New Chemical Entities towards ‘Translational Research’ ”.
	Date	21st February, 2017
10.	Speaker	Dr. Rupak Bhadra, Chief Scientist of Infectious Disease and Immunology Division of CSIR IICB.
	Title	‘Regulation of nutritional starvation stress in the cholera pathogen Vibrio cholerae’.
	Date	10th March, 2017 at 4 PM, Dr. J. C. Ray Auditorium

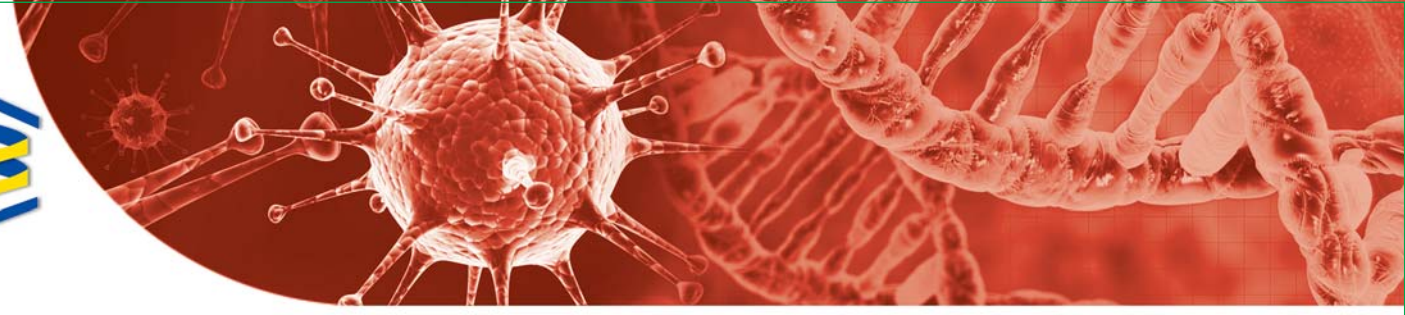
SEMINAR APRIL 2016 to MARCH 2017

1.	Speaker	Dr. Kaustabh Kumar Maiti, Senior Scientist, CSTD,CSIR-National Institute of Interdisciplinary Science and Technology (NIIST),Trivandrum.
	Title	"Guanidine Appended Targeted Drug-delivery System (TDDS): A Future Prospect in Cancer Therapy".
	Date	11th April, 2016 at 4 PM, B. K. Bacchawat Hall
2.	Speaker	Dr. Samarendra K Singh, University of Virginia, Charlottesville, Virginia, USA.
	Title	"Regulation of Cell Cycle and Replication in Cancer Cells".
	Date	3rd May, 2016 at 4 PM, B. K. Bacchawat Hall
3.	Speaker	Satyaki Roy, Graduate Student, University of Missouri – Rolla, US
	Title	"Characterization of E. coli gene regulatory network and its topological enhancement by edge rewiring".
	Date	June 17, 2016 at 3 PM, B. K. Bacchawat Hall
4.	Speaker	Amit Kumar Chattopadhyay, Ph.D., University de Montreal, Montreal, Quebec, Canada.
	Title	"Natural product synthesis-A long journey".
	Date	20th July, 2016 at 4 PM, B. K. Bacchawat Hall
5.	Speaker	Dr. Sudipta Das, Drexel University College of Medicine, Philadelphia, Pennsylvania, USA
	Title	"Novel anti-malarials targeting Na+ and cholesterol homeostasis in Plasmodium falciparum"
	Date	27th July, 2016 at 4 PM, B. K. Bacchawat Hall
6.	Speaker	Dr. Prabuddha Mukherjee, Department of Bioengineering Beckman Institute of Advanced Science and Technology, University of Illinois at Urbana Champaign USA
	Title	"MULTIMODAL IMAGING IN BIOLOGICAL SYSTEMS".
	Date	3rd August, 2016 at 4 PM, B. K. Bacchawat Hall
7.	Speaker	Dr. Partha Sarkar, Associate Professor at Department of Neurology, UTMB, Galveston, Texas USA
	Title	"CAG repeat expansion: the mechanism of neuronal dysfunction and neurodegeneration in Huntington's disease"
	Date	8th August, 2016 at 4 PM, B. K. Bacchawat Hall
8.	Speaker	1) Srini V. KAVERI, Director, CNRS Office in India "Embassy of France" New-Delhi – India 2) Dr. Partha Chakrabarti, Senior Scientist, CSIR-IICB, Kolkata-32 3) Dr. Krishnananda Chattopadhyay, Principal Scientist, CSIR-IICB, Kolkata-32



SEMINAR APRIL 2016 to MARCH 2017

	Title	1) "Antibodies: Revisiting the good and bad samaritans" 2) "Diabetes: A fatty affair" 3) “The nitty gritty of a protein 'snitch': the story of 'le vilain' “
	Date	16th August, 2016 at 11.30 AM, Dr. J. C. Ray Auditorium
9.	Speaker	Dr. Budhaditya Mukherjee, Department of Microbiology and Molecular Medicine, University of Geneva, Switzerland.
	Title	Structure-function relationships of Toxoplasma gondii aspartyl protease 3.
	Date	24th August, 2016 at 4 PM, B. K. Bacchawat Hall
10.	Speaker	Dr. Biswajoy Roy-Chaudhuri, Adaptive Biotechnologies, SouthSan Francisco, CA, USA
	Title	“Role of non-coding RNA processing in controlling RNA structure & function”.
	Date	30th August, 2016 at 4 PM, B. K. Bacchawat Hall
11.	Speaker	Dr. Hiyaa Ghosh, PhD, Asst. Professor, NCBS, Bangalore
	Title	'Cellular mechanisms in the adult brain'
	Date	2nd September, 2016 at 4 PM, B. K. Bacchawat Hall
12.	Speaker	Dr. Saumitra Sengupta, Former Vice President, Aurigene Discovery Technologies, Bangalore.
	Title	“Androgen Deprivation therapy for prostate cancer”.
	Date	8th September, 2016 at 4 PM, B. K. Bacchawat Hall
13.	Speaker	Prof. Tanya Das, Bose Institute, Kolkata Dr. Arnab Gupta, Director, SGCCRI, Kolkata, (Thakurpukur Cancer Hospital)
	Title	“Contribution of cancer stem cells in breast cancer relapse: An approach towards a targeted therapy”. Combating Cancer- Clinician's perspective
	Date	27th September, 2016 at 4 PM, Dr. J. C. Ray Auditorium
14.	Title	Indo-Brazil Symposium
	Date	19-20th September, 2016
15.	Speaker	CSIR FOUNDATION LECTURE 28th September, 2016 Prof. Shekhar C. Mande, Director, National Centre for Cell Science, Pune.
	Title	“Mapping Protein Flexibility”.
	Date	28th September, 2016 at 12.15 PM, Dr. J. C. Ray Auditorium
16.	Speaker	Nitya G. Chakraborty, Associate P rofessor of Medicine, University of Connecticut, USA
	Title	“Cell mediated immunotherapy for cancer and the and immune-regulation”.
	Date	23rd November, 2016 at 4 PM, Dr. J. C. Ray Auditorium



SEMINAR APRIL 2016 to MARCH 2017

17.	Speaker	Dr. Manas K. Santra, Scientist, National Center for Cell Science, Pune
	Title	F-box protein FBXO31 protects from oncogenic transformation through activation of cell cycle check points
	Date	24th November, 2016 at 4 PM
18.	Speaker	Dr. Tatini Rakshit of Department of Bioengineering, New York University, USA
	Title	"Applications of Scanning Probe Methods in Biology at the Nanoscale".
	Date	1st December, 2016 at 4 PM, B K Bachhawat Hall
19.	Speaker	Arnab Gupta, PhD, Wellcome Trust-DBT India Alliance Intermediate Fellow, SN Pradhan Centre for Neurosciences, University of Calcutta, 35, Ballygunje Circular Road, Kolkata – 700019, India.
	Title	"Regulatory mechanism of human copper transporter ATP7B, the 'Wilson Disease' protein".
	Date	15th December, 2016 at 4 PM, B. K. Bachhawat Hall
20.	Speaker	Prof. Kalpana Ghoshal of The Ohio State University Comprehensive Cancer Center – Arthur G. James Cancer Hospital and Richard J. Solove Research Institute (OSUCCC – James).
	Title	"Role of miR-122 in hepatocarcinogenesis".
	Date	13th January, 2017 at 4 PM, B. K. Bachhawat Hall
21.	Speaker	Dr. Chinmoy Kumar Hazra, Center for Catalytic Hydrocarbon Functionalization, Institute for Basic Science (IBS) and Dept. of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea.
	Title	"Exploring New Facets of Organic Synthesis: From Metal to Metal-Free Catalysis".
	Date	31st January, 2017 at 3 PM, B. K. Bacchawat Hall
22.	Speaker	Dr. Avijit Dutta, Division of Infectious Diseases, Department of Medicine, Chang Gung Memorial Hospital, Taiwan.
	Title	"T cell immunity: regulation of activation & reversal of regulation".
	Date	2nd February, 2017 at 4 PM, B. K. Bacchawat Hall
23.	Speaker	Dr. Koushik Roy, Signaling Systems Lab,University of California, Los Angeles, USA.
	Title	"A step towards to predict immune response".
	Date	28th February, 2017 at 4 PM, B. K. Bacchawat Hall

THE LAURELS

	Awardees	*Award / recognition*
	**Dr. Rupak K. Bhadra**	Fellow of the National Academy of Sciences (FNASc) 2016
	**Dr. G. Suresh Kumar**	Fellowship of the Royal Society of Chemistry (FRSC), UK 2016
	**Dr. Surajit Ghosh**	Young Scientist Award from Indian Peptide Society, February 2017

Dr. SUVENDRA NATH BHATTACHARYYA

Shanti Swarup Bhatnagar Prize in Biological Sciences 2016

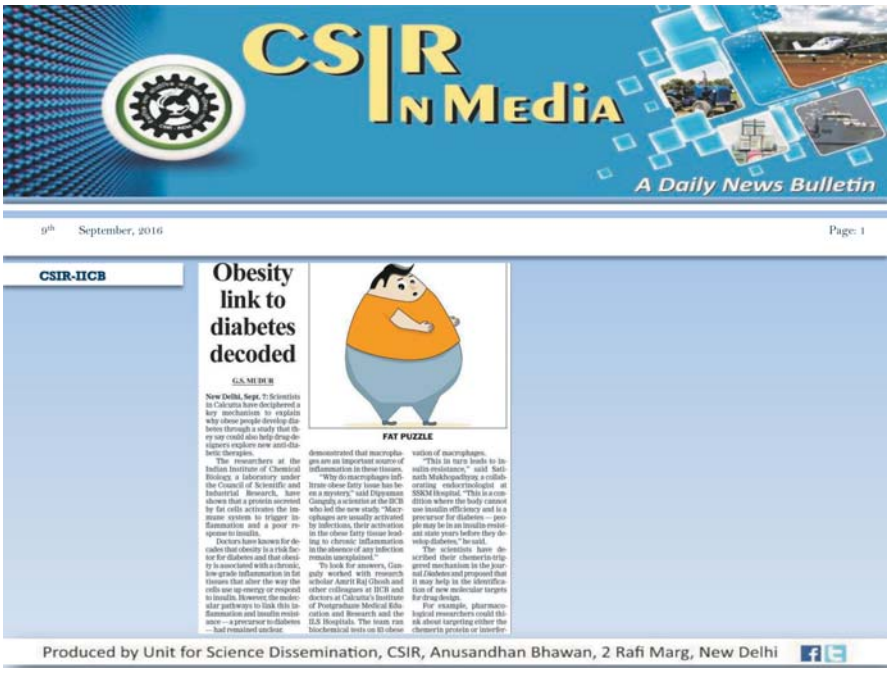
2017: Fellowship Section to National Academy of Sciences (NASI), India

2017: CDRI award 2017 for excellence in drug research

2017: Fellowship Selection to Indian Academy of Sciences (IAS), Bangalore

2016: Shanti Swarup Bhatnagar Award for Science and Technology (BiologicalSciences), Ministry of Science and Technology, Government of India

CSIR -IICB in News-UpcomingTechnology



CSIR In Media

A Daily News Bulletin

9th September, 2016 Page: 1

CSIR-IICB

Obesity link to diabetes decoded

G.S. MUDUR

New Delhi, Sept. 7: Scientists in Calcutta have deciphered a key mechanism to explain why obese people develop diabetes through a study that they say could also help drug designers explore new anti-diabetic therapies.

The researchers at the Indian Institute of Chemical Biology, a laboratory under the Council of Scientific and Industrial Research, have shown that a protein secreted by fat cells activates the immune system to trigger inflammation and a poor response to insulin.

Doctors have known for decades that obesity is a risk factor for diabetes and that obesity is associated with a chronic, low-grade inflammation in fat tissues that alter the way the cells use up energy or respond to insulin. However, the molecular pathways to link this inflammation and insulin resistance — a precursor to diabetes — had remained unclear.

FAT PUZZLE

demonstrated that macrophages are an important source of inflammation in these tissues.

"Why do macrophages infiltrate obese fatty tissue has been a mystery," said Dipyaman Ganguly, a scientist at the IICB who led the new study. "Macrophages are usually activated by infections, their activation in the obese fatty tissue leading to chronic inflammation in the absence of any infection remain unexplained."

To look for answers, Ganguly worked with research scholar Amrit Raj Ghosh and other colleagues at IICB and doctors at Calcutta's Institute of Postgraduate Medical Education and Research and the ILS Hospitals. The team ran biochemical tests on 83 obese

vation of macrophages.

"This in turn leads to insulin-resistance," said Satinath Mukhopadhyay, a collaborating endocrinologist at SSKM Hospital. "This is a condition where the body cannot use insulin efficiency and is a precursor for diabetes — people may be in an insulin-resistant state years before they develop diabetes," he said.

The scientists have described their chemerin-triggered mechanism in the journal *Diabetes* and proposed that it may help in the identification of new molecular targets for drug design.

For example, pharmacological researchers could think about targeting either the chemerin protein or interfer-

Produced by Unit for Science Dissemination, CSIR, Anusandhan Bhawan, 2 Rafi Marg, New Delhi

10

The Telegraph KnowHOW

DE-LIVERED: THE EATING GOOD NEWS

Calcutta scientists may have found a way to tame the non-alcoholic fatty liver, says T.V. Jayan

মোটা? জানুন সুগারের আভাস

উপায় বাতলাচ্ছে কলকাতা

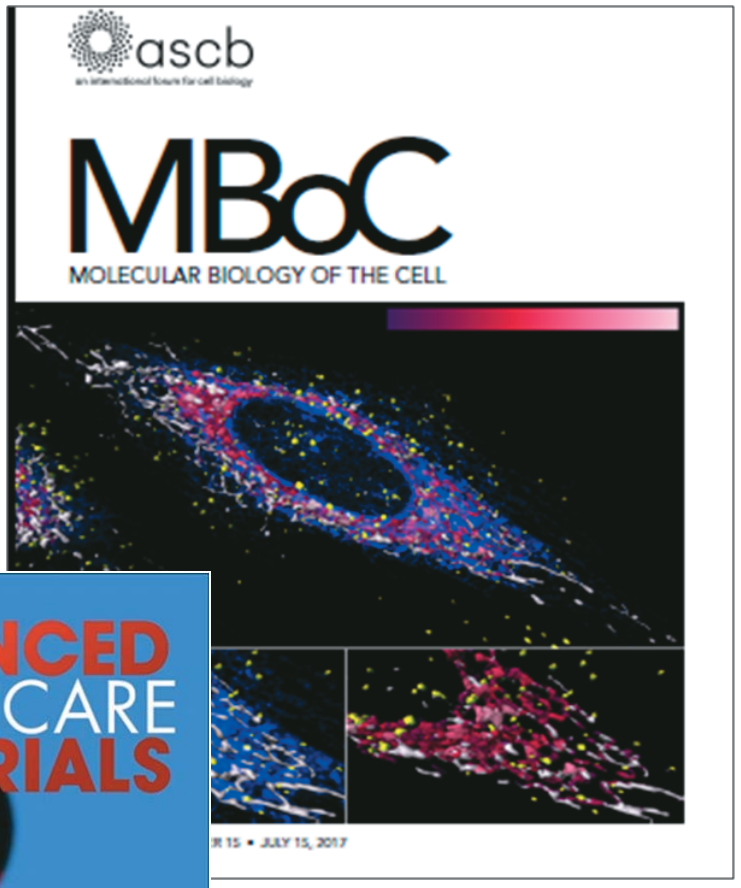
মেদ জমলে বিপদ-বৃত্তে

রাজ্য

সুগারের আভাস

COVER PAGES OF JOURNALS

Tetrahedron Letters
28th September, 2016



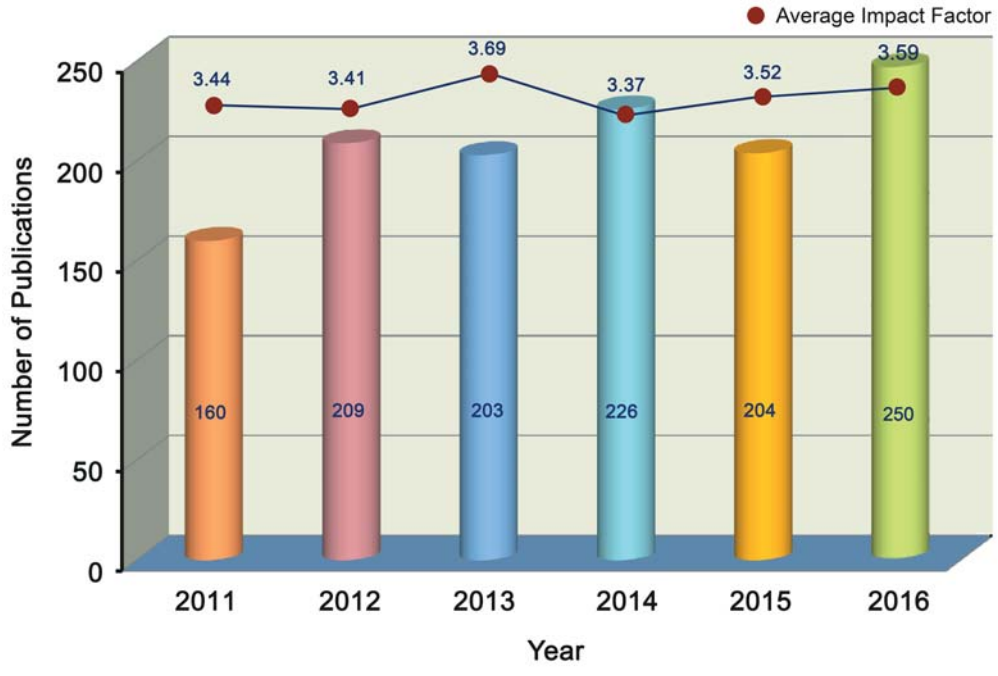
Molecular Biology of the Cell, Vol. 20,
15th July, 2017

Advanced Healthcare Materials, Vol. 6,
2nd January, 2017

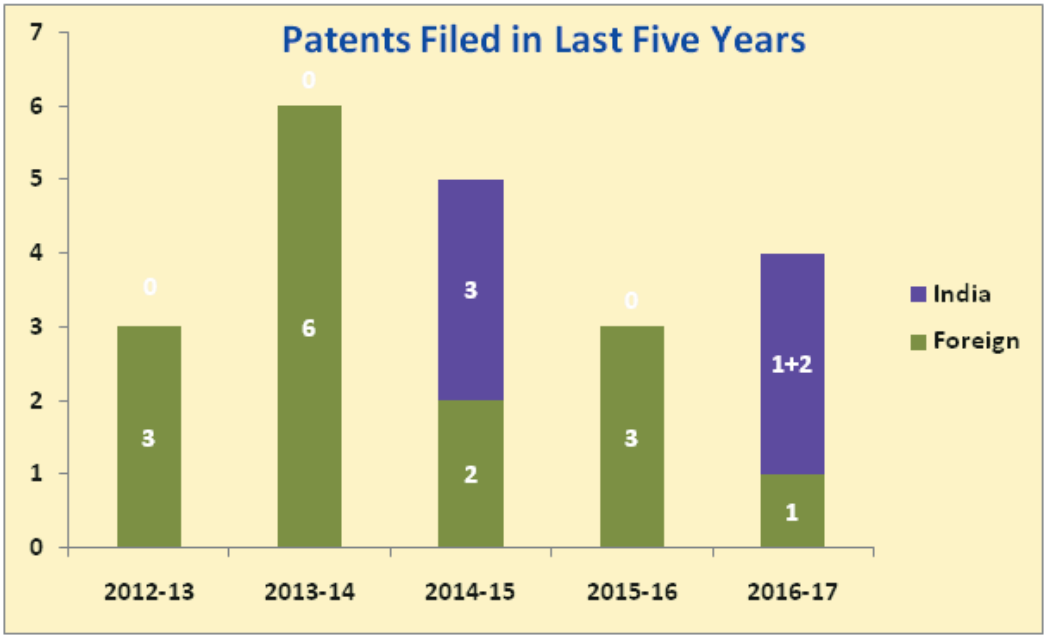
PUBLICATIONS

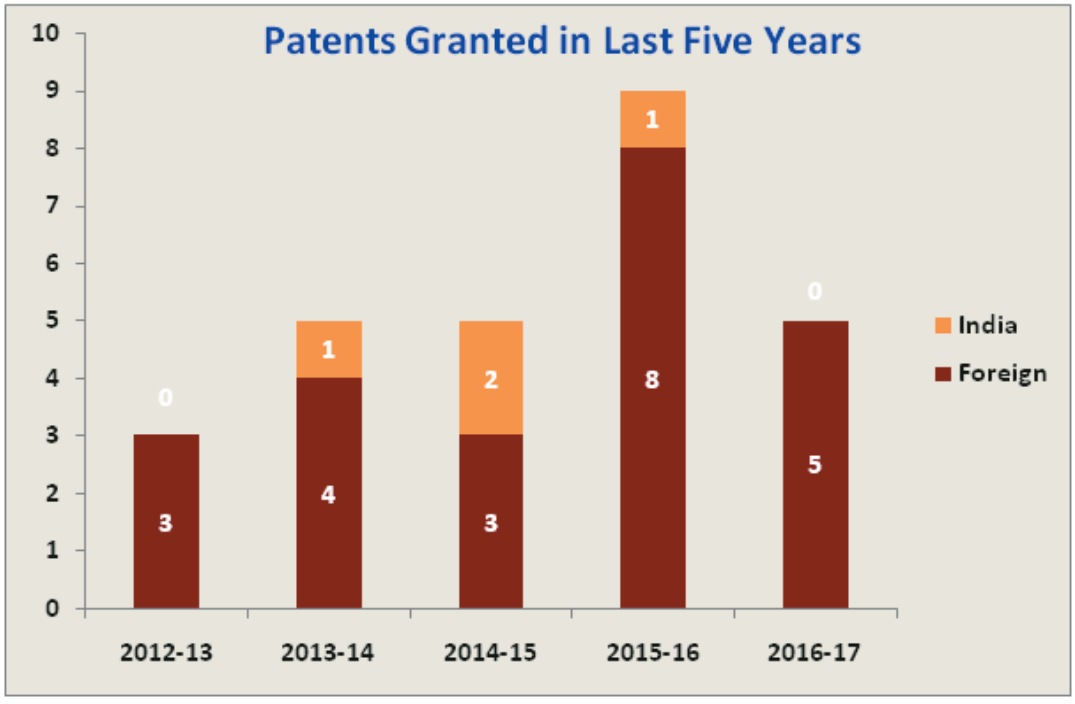
Research Publication 2016

Total Publications	250.00	
	09.00	Non SCI Publications
SCI Publications	241.00	
	2.00	No. of Papers with IF > 10
No. of Papers with IF ≥ 5 < 10	29.00	
	53.00	No. of Papers with IF ≥ 4 < 5
No. of Papers with IF ≥ 3 < 4	63.00	
	60.00	No. of Papers with IF ≥ 2 < 3
No. of Papers with IF ≥ 1 < 2	29.00	
	05.00	No. of Papers with IF < 1
Total IF (2016)	864.47	
	3.59	IF per Research Publications (SCI)

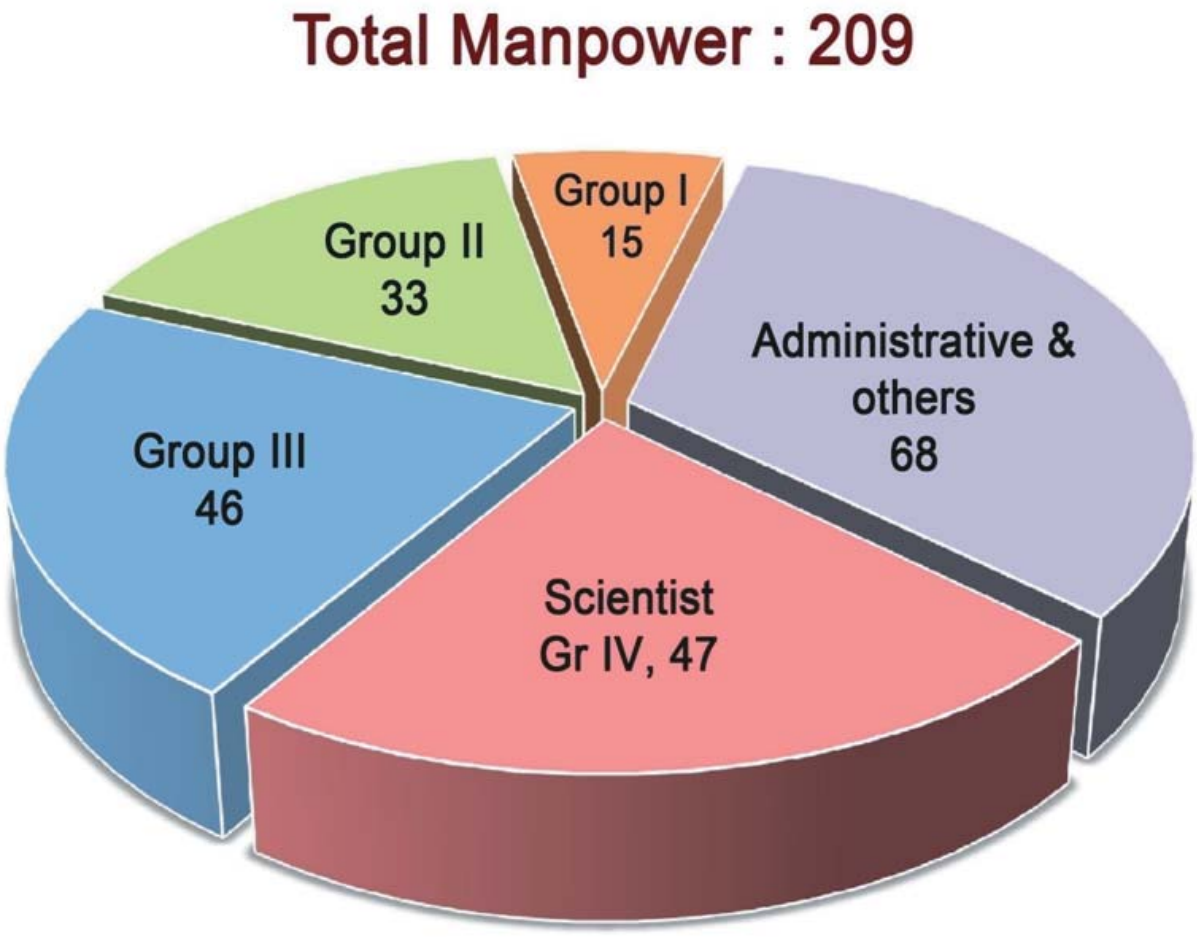


PATENTS

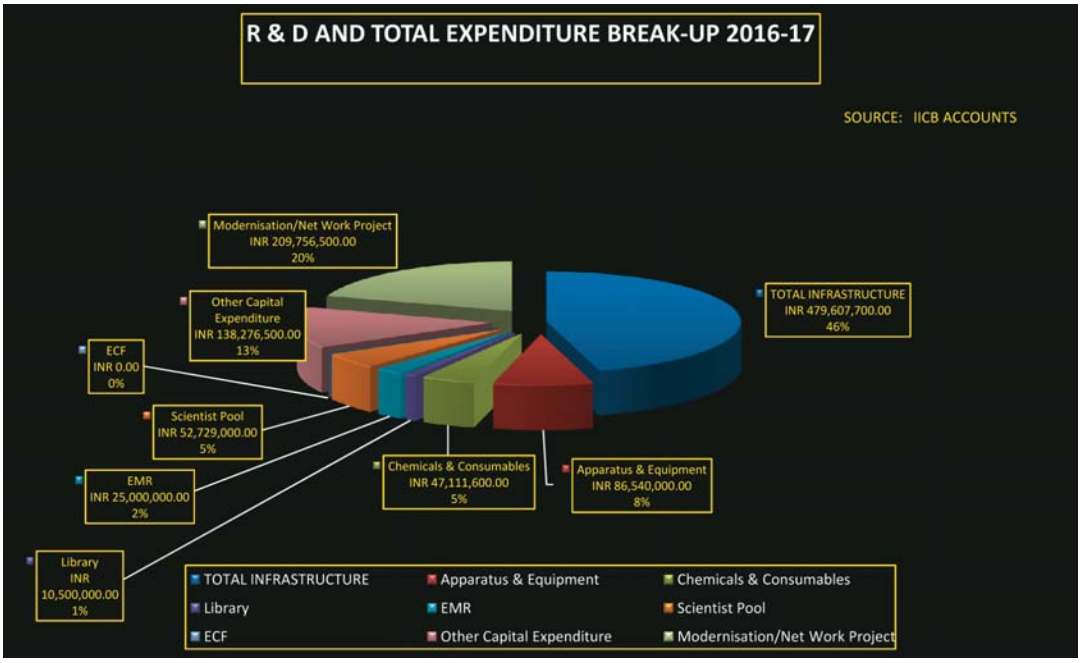

Patents Filed in Last Five Years
7
6
5
4
3
2
1
0
0
3
6
3
2
3
1+2
1
India
Foreign
2012-13
2013-14
2014-15
2015-16
2016-17

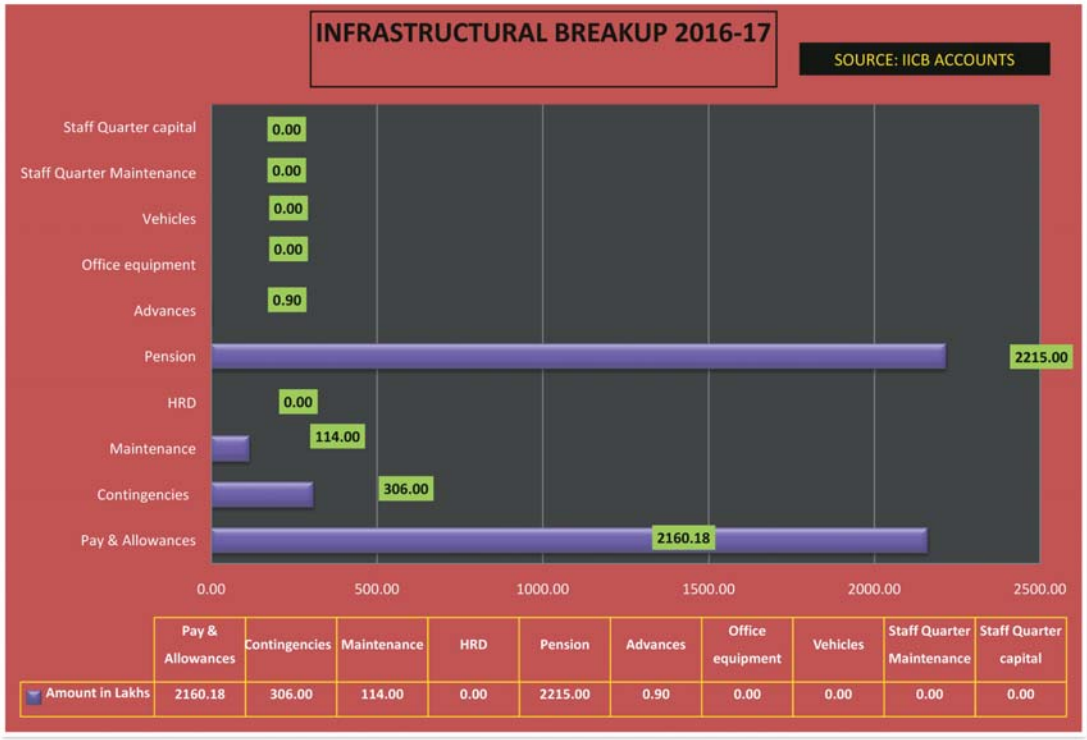

Patents Granted in Last Five Years
10
9
8
7
6
5
4
3
2
1
0
0
3
1
4
2
3
1
8
0
5
India
Foreign
2012-13
2013-14
2014-15
2015-16
2016-17

HUMAN RESOURCE DEVELOPMENT

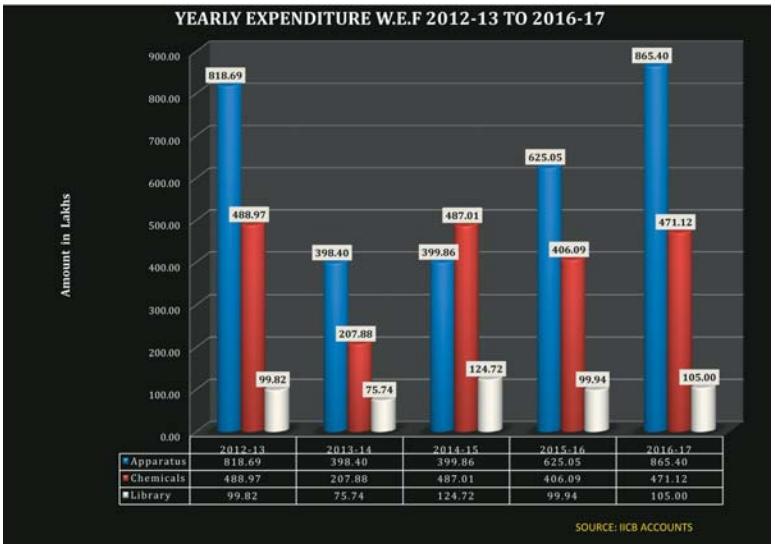


Scientist : Technical Staff : Administrative Staff :: 47 : 94 : 68

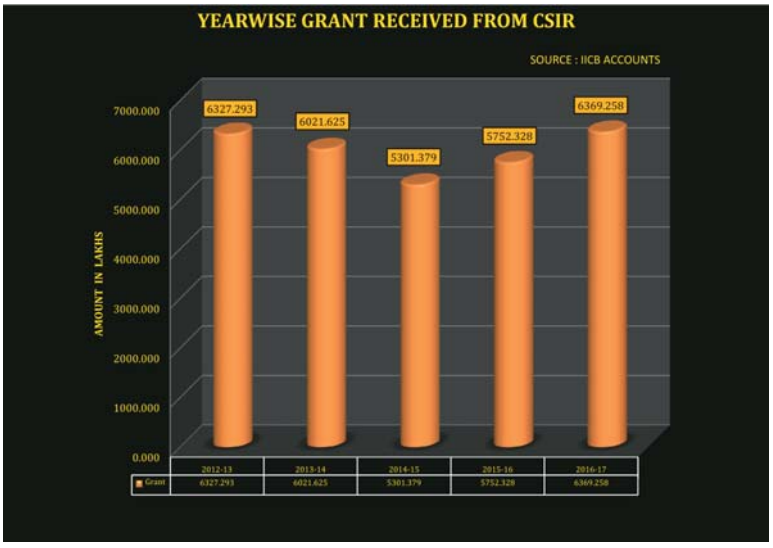




	Pay & Allowances	Contingencies	Maintenance	HRD	Pension	Advances	Office equipment	Vehicles	Staff Quarter Maintenance	Staff Quarter capital
Amount in Lakhs	2160.18	306.00	114.00	0.00	2215.00	0.90	0.00	0.00	0.00	0.00


YEARLY EXPENDITURE W.E.F 2012-13 TO 2016-17
Amount in Lakhs
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
818.69
488.97
99.82
398.40
207.88
75.74
399.86
487.01
124.72
625.05
406.09
99.94
865.40
471.12
105.00
2012-13 2013-14 2014-15 2015-16 2016-17
Apparatus 818.69 398.40 399.86 625.05 865.40
Chemicals 488.97 207.88 487.01 406.09 471.12
Library 99.82 75.74 124.72 99.94 105.00
SOURCE: IICB ACCOUNTS


EXTERNAL CASH FLOW OF IICB
SOURCE: IICB ACCOUNTS
AMOUNT IN LAKHS
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
489.54
460.67
466.17
464.67
1382.765
2012-13
2013-14
2014-15
2015-16
2016-17
2012-13 2013-14 2014-15 2015-16 2016-17
ECF 489.54 460.67 466.17 464.67 1382.765


YEARWISE GRANT RECEIVED FROM CSIR
SOURCE : IICB ACCOUNTS
AMOUNT IN LAKHS
7000.000
6000.000
5000.000
4000.000
3000.000
2000.000
1000.000
0.000
6327.293
6021.625
5301.379
5752.328
6369.258
2012-13 2013-14 2014-15 2015-16 2016-17
Grant 6327.293 6021.625 5301.379 5752.328 6369.258

HUMAN RESOURCE GROUP (HRG)

Dr. Siddhartha Majumdar, Ms. Arti Khetrapaul, Ms. Debasree Das and Md. Ayub Shah

Human Resource Group (HRG) of CSIR-IICB promotes professional Human Resources Management in this institute by evolving and implementing HR development plan. The HRD group represents a central group of the laboratory and is involved in a wide range of HRD related activities in various areas of core competence of the lab and also related to research scholars.

The major area where HR group contributes: Activities related to Academic–Administration concerning PhD program, student affairs, post-graduate training programme, and different other training program.

The functions include: oversight, guidance and co-ordination of different HR development program & talent-management activities. HRG section function as a coordinating centre for the CSIR-IICB PhD course work for the PhD students.

Activities, Guidance and Initiatives:

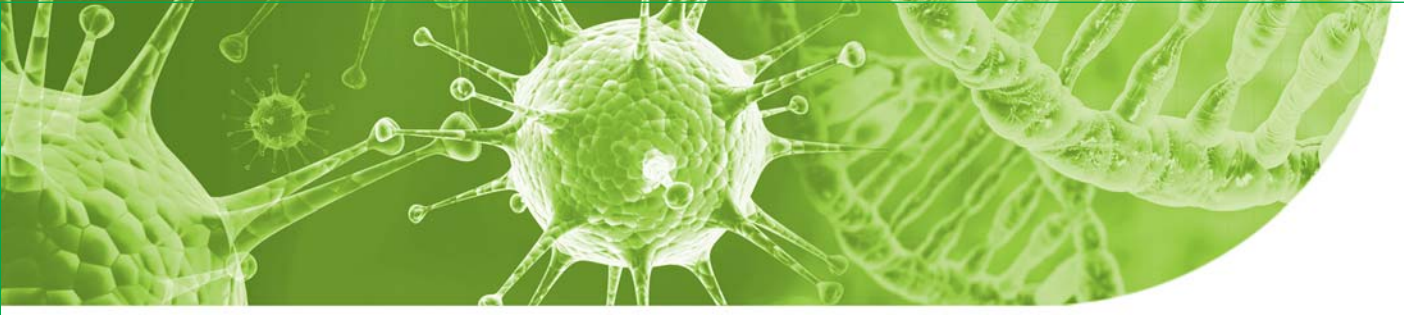
Student Affairs

1) PhD course work and PhD program: Management of academic calendar, course administration and curriculum planning, attendance and class schedule, Coordination with the teachers, management of semester examinations, evaluation, seminar, and publication of result & issuance of certificates.

2) Maintenance of PhD registration databases, academic records of PG summer/winter trainees and coordination of Academic Affairs meeting.

3) Scrutinization of applications for PhD registration and documents of RFs/RAs related to academic affairs to be endorsed.

4) NET JRF entrance interview: Information, web notification, decide on number of NET JRFs intake etc.



5) Content development for Research fellow's handbook, publication of course catalogue, teachers guideline, academic Calendar and different guidelines related to IICB PhD program and PhD course work.

6) Organization of science communication and presentation skill development program for the PhD course work students

7) Organization of Orientation programme for PhD students

8) Interacting and coordinating with CSIR HRD.

Human Recourses

PhD students, post-docs & project assistants (Up to March 2017)

At a Glance:

Number of existing Research Fellows & Associates: 263

(CSIR/UGC/DST/DBT/ICMR/TLP)

Number of Project Assistants: 44

Summer Training / Project Work / Dissertation Work

HRG coordinates Summer Training Programme for the eligible Post Graduate students of different Universities, Institutions and Colleges for partial fulfilment of their degrees. The aim is to let young minds feel the thrill and excitement of science by working on a project requiring application and critical appreciation of scientific principles. It also aims at active participation in the learning process through experimentation and putting into practice the knowledge acquired in the classrooms.

The summer program is primarily designed to provide the opportunity to do basic research in top-notch research areas, in a supportive learning environment with plenty of interaction with PhD research fellows and faculty members. Detailed guidelines are made available in CSIR-IICB website.

Number of Summer Trainee/Project Trainee (2016-17): 72

Learning and instructional support

Academic Affairs

The overall academic affairs of the institute are the primary focus of this Division. All these activities were successfully carried out in functions related to CSIR-IICB PhD Course Work program and also to extend academic -administrative affairs of AcSIR activities in this institute. The CSIR-IICB Academic Affairs Committee, acts as an Advisory Committee to the Academic Affairs Division/HRG in connection with CSIR-IICB PhD program including AcSIR programme .

CSIR-IICB PhD Course Work (CW)

To educate and train in multidisciplinary areas, CSIR-IICB offers a mandatory PhD course work for the Research Fellows in their first year, taught by faculty members of in-house as well as from other Institutes/Universities. The framing of the course content & guidelines is designed in the line of AcSIR courses as well as per UGC requirement.

The existing CSIR-IICB PhD Course Work programme constitutes basic and advanced level courses. The basic course is for bridging the gap between M.Sc. and PhD. The advanced level course comprises of frontline areas of research and covers research methodology and review of current literature.

IICB PhD CW comprises of three level of courses viz 100, 200 & 300 level [total 12 credits]:

Level 100 [basic courses] (Total 4 credits, all compulsory): Computation / Bioinformatics; Basic Chemistry; Introduction to Chemical Biology; Research Methodology, Communication/ Ethics/ Safety; Biostatistics

Level 200 [mid level courses] (Total 4 credits): Biotechniques and Instrumentation, Biology of Macromolecules, Protein Science and proteomics, Molecular and Cellular Immunology, Cell Biology & Cell Signaling, Advanced Analytical Chemistry, Advanced Organic Chemistry, Green Chemistry, Advances in Nanoscience and Nanotechnology.

Level 300 [advanced level Course] (Total 4 credits): Cancer Biology, Eukaryotic Gene Regulatory Mechanism, Cell & Tissue Engineering, Chemical Biology, Natural Products and Drug Discovery, Total Synthesis, Supramolecular Chemistry.

HRG functions as overall coordinating centre for the CSIR-IICB PhD course work for the PhD students. The PhD course work is carried out with the advice of Chairperson & members of Academic Affairs Committee and the Examination committee constituted for this purpose.

Total number of Course work students for 2017: 47 (Chemistry - 16, Biology - 31)

Program organized by HRG-IICB:

An Orientation Program for newly recruited CSIR-IICB Ph.D Research Fellows was organized on 7th February, 2017 at CSIR-IICB. About 47 students (2017 Course work batch) participated in this program. Prof. Samit Chattopadhyay, Director CSIR- IICB, Dr. Uday Bandyapdhyay, Chairperson, AAC, Dr. Arun Bandyopadhyay, Dr. Rukhsana Chowdhury, Dr. Sib Sankar Roy, Dr. Partha Chakrabarti and Dr. Siddhartha Majumdar were present in the program. Important guidelines about the PhD Course Work and course content were informed by the Head HRG.

Training Programme

Nominated/recommended for participation:

- Dr. Siddhartha Majumdar, Head HRG was nominated for participation in the 'HR Group Heads meet conducted by CSIR-HRDC' held on 01 September, 2016, at CSIR-HRDC, Ghaziabad.
- Mrs. Ambalika Nag, Hindi Officer, was nominated for participation in the 3 day programme 'Work-Life Balance for Women Scientists and Officers' held at CSIR-HRDC, Ghaziabad from 21 – 23 December, 2016.
- Following Officials were nominated for participation in the programme organized by CSIR-HRDC on 'Managerial Effectiveness for Common Cadre Officers' held from 09 – 11 January, 2017 at CSIR-CGCRI Kolkata:

Shri Suprokash Halder, AO; Shri Sudipto Chatterjee, F&AO; Shri A. K. Pandey, S&P O; Dr. G. Suresh Kumar, Chief Scientist & Head, PME, P&I, BDG and Purchase committee; Dr. Surajit Ghosh, Principal Scientist; Shri V.K. Gond, Section Officer (G)

Associated Members:

Ms. Arti Grover, Ms. Debasree Das, Md. Ayub Shah

COMPUTER DIVISION

CSIR-IICB Jadavpur Campus:

Dr. Sucheta Tripathy (Head), Dr. Subhagata Ghosh, Mr. Pradeep Sypureddi and Mr. Shiv Kumar Gupta

CSIR-IICB TRUE Salt Lake Campus:

Dr. Saikat Chakrabarti (IT In-charge), Mr. Akash Gupta

Introduction

Computer Division is the IT backbone of CSIR-IICB infrastructure, which continuously strives to cater the need of computer and IT related services of users in research, administration, learning and personal communications.

The Division helps in providing support to Desktops, Laptops, Printers, Scanners, Software's, Video Conferencing, Biometric System and Network infrastructure services from time to time along with setup and maintenance.

The Division also provides secured network services including the design of campus wide LAN/WAN solutions and internet /intranet solutions besides providing computing services to ongoing R&D projects and conducting periodical training programs. The IT group has been in the forefront of deploying information technologies to help our Faculty members, students & other staff members.

The Division has extended its services to CSIR-IICB TRUE, Salt Lake campus along with Point to Point connectivity along with bandwidth capacity of 10 Mbps. The present CSIR-IICB Network facility management system has been upgraded with latest technologies like MAC Authentication for Wi-Fi Users, NIC Webmail, VPN etc. The ILL connection from NKN has been upgraded to 1G.

IICB Intranet

IICB Websitre

Infrastructural Activities

- Internet connectivity to all scientists, staff and students of IICB
- E-mail service for IICB staff members including scientists, technical & administrative staffs and students
- Infrastructure procurement, installation and maintenance of all IT connectivities
- Technical support to Biometric Attendance System
- Technical support to Video Conferencing facility and its maintenance
- Electronic Display System services for various types of official instant notices
- Management and maintenance of high performance central servers like DHCP server, DNS server, Proxy server, IICB Web server, NIC Distribution List etc.
- Making infrastructural provision for network management system with high speed router, switches and other network accessories.
- Call assignment and coordination with AMC Staff for user support services including software and hardware installations for laptops, desktops, printers, scanners and all other computer peripherals.

Networking Facilities

- Wired and Wireless Networking solutions and services (including NIPER Office and Student Hostel) like LAN and Wi-Fi
- VPN network service management
- Providing cyber security of the network through Firewall and Radius servers

Web Services

- Design and maintenance of IICB Website and Intranet
- Development and maintenance of conferences' and societies' website

New Initiatives:

- Employee Email system migrated to NIC
- New group communication emails introduced with NIC Distribution List.
- Classes for JIGYASA Program 2017
- Upgradation of NKN ILL connection to 1G
- Upgradation of Point to Point connectivity with 10 Mbps between CSIR-IICB TRUE, Salt Lake campus and CSIR-IICB Jadavpur campus
- Upgradation of LAN System to 10G at Jadavpur Campus, CSIR-IICB
- Setup of Data Centers in both the campuses of CSIR-IICB with infrastructure facilities like cooling, UPS and humidity controlling systems
- Extension of Services like LAN, Wi-Fi, Biometric and Internet Services to Salt Lake Campus CSIR-IICB TRUE

CSIR - IICB Server Room, Jadavpur Campus

CSIR - IICB TRUE Server Room, Salt Lake Campus

Computer Division, Jadavpur Campus.

Classes for JIGYASA program Computer Division, CSIR-IICB

Library & Documentation Division
Knowledge Resource Centre (KRC)

Dr. N.C. Ghosh, Mr. S.K. Naskar, Mrs. S. Ganguly, Mr. M. Halder, Mr. S. Nath and Mr. Asoke Ram

During this reporting period also the Knowledge Resource Centre (Library) has been continuing its pivotal role as one of the important infrastructure division by providing literature supports to the users. As a growing organism, the division has marked growth in collection, systems, facilities and services.

Collections	Up to 31.03.2017
Books (including Hindi)	14430
Journals (online only)	109
Bound volumes	33860
Science-Direct (Back files)	202 journals full
(http://www.iicb.res.in/bkfiles_library.html)	text up to 1994
Thesis (CDs)/online	326
Newspapers (English, Bengali & Hindi)	3

National Knowledge Resource Consortium (NKRC), NISCAIR, New Delhi is a very strong network of the CSIR & DST Institutions are jointly working towards catering best possible information services to their users. CSIR-IICB has been accessing in full text of about more than 1500 (thousand) STM journals through NKRC in addition to the subscribed content by IICB.

Thenticate – plagiarism detection service is available in the Library & Documentation Division for reviewing the manuscripts by the researchers.

IICB has been subscribing the 'Web of Science' and providing various tailor-made services according to the needs of the Scientists.

The KRC is having a cosy Reading Room with a beautiful e-resources access corner for the users. The other services include photocopying service, Circulation service, Article delivery service through resource sharing, plagiarism checking for the manuscripts and the division has provided various other services during the period under reporting.

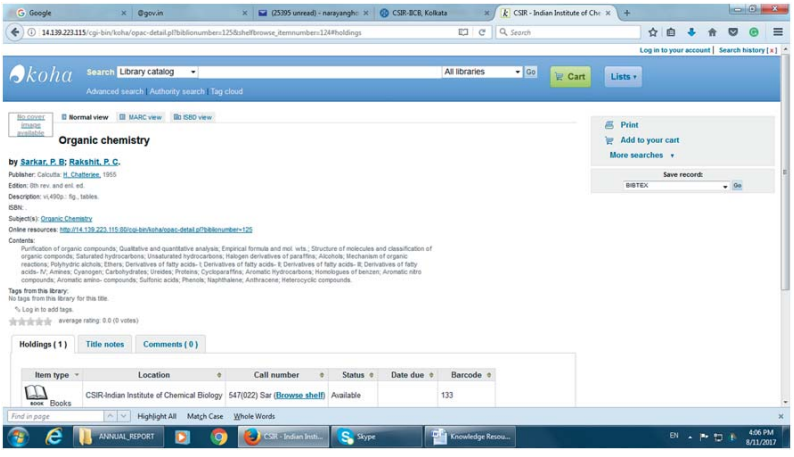
E-journals/database access corner with thirty desktop computers

CSIR Virtual Union Catalogue using KOHA

The functions and services of the KRC are computerized using 'LIBSYS'. The Online Public Access Catalogue (OPAC) is available at http://14.139.223.107:8080/webopac/html/SearchForm which has been utilized as a very useful tool for searching library holdings.

Open Access Repository (IR) maintaining in E-prints for archiving peer reviewed journals articles, Conference papers, Theses and other research documents produced by IICB researchers. The URL for accessing the repository is http://www.eprints.iicb.res.in. So far 1850 documents in full-text have been uploaded to the repository.

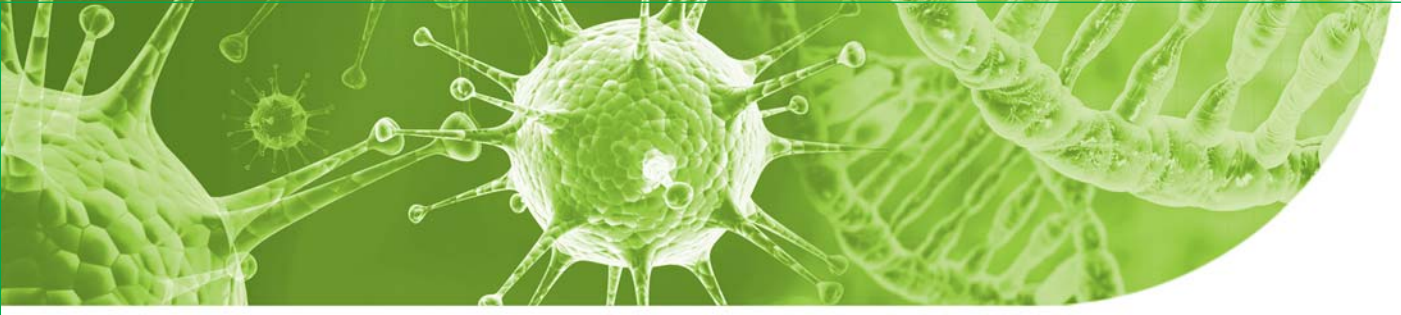
NIPER- Knowledge Resource Centre has been functioning as a separate unit in the library premises since its inception and catering services to the NIPER- Kolkata students and faculty members. Presently a total of 1092 text & reference books is available in its holdings till date. The subscription to 'SciFinder Scholar' was continued until February 2017.



CENTRAL INSTRUMENTATION DIVISION

Dr. Sib Sankar Roy (Head), Dr. Indubhusan Deb (Deputy Head), Dr. Umesh Prasad Singh, Mr. Shekhar Ghosh, Dr. Mrs. Shila Elizabeth Besra, Dr. Tapas Sarkar, Dr. Ramdhan Maji, Dr. Ardhendu Kumar Mandal, Mr. R.N. Mandi, Dr. E. Padmanaban, Mrs. Banasri Das, Mr. Diptendu Bhattacharya, Mr. Sandip Chowdhury, Mr. Sandip Chakraborty, Mr. Jishu Mandal, Mr. T. Muruganandan, Mr. Bhaskar Basu, Mr. Binayak Pal, Mr. Sounak Bhattacharya, Mr. Soumik Laha, Mr. Sandip Kundu, Mr Anirban Manna, Mr. Santu Paul, Mr. M. Vigneshwaran, Smt. Dipika Roy, Mr. Tapas Chowdhury, Mr. K. Suresh Kumar, Mr. Tarak Prasad Nandi and Mr. Hari Shankar Beni, Mr. Nimai Charan Pradhan

Central Instrumentation Facilities (CIF) Division provides state of the art facilities and support to researchers at IICB as well as others from different academic and R&D organizations. The main objective of this division is to provide the accurate experimental data to the researchers with the help of sophisticated instruments. We now have about 30-40 high end and sophisticated instruments under CIF, which provides the excellent opportunity to the researchers across India. Many of these instruments have dedicated and well-trained operators for smooth running and high quality data acquisitions. This is indeed a pleasure for us to share that a few new equipmentslike 400 MHz NMR (JEOL) and GC-MS have been inducted to the facilities this year. We plan to procure more high-end instruments in the coming years.



CIF-IICB organizes special hands on training sessions in a regular fashion for students as well as staff members of our Institute as well as for the members from other Institutes totrain them about the principle and application of the machine as well to give them hands on experience of using the machine themselves.For example, trainings are organized in microscopy (Confocal and TEM), Flow Cytometry, etc. CIF at IICB has also demonstrated and trained college students about different instruments. For the research fellows of our Institute a taking course work is mandatory to pursue PhD and in this course work Instrumentation and techniques happens to be a paper each student must has to opt. In this course, theoretical and practical aspects of relevant Instruments for Biology and Chemistry students are provided by the experienced faculty and the technical operators.

The entire list of instruments of central instrumentation is available on the IICB webpage with their physical location. The process of booking the time slot to use the instruments are mentioned for most of the instruments. CIF at IICB has the motto of providing service to each and every user following proper logistics, where maximum possible service is provided to satisfy the need of all. The data collection charges and the process of booking is also made available through IICB webpage, which allows easy access of these instruments for all.

We still feel that there is a lot of scope to further improve the service and CIF. We have a major plan to make a separation unit comprising HPLCs, FPLCs, GCs to separate both types of chemical likesmall molecules as well as macromoleculesin one subsection to help both Chemists as well as Biology researchers. Similar plan will also be taken for the imaging unit, which include, Confocal microscopes, live cell confocal microscopes, inverted microscopes and high resolution confocal microscopes etc, which may be kept in close proximity with TEM, Cryo-TEM room, AFM and SEM rooms.Similarly, all three NMR instruments are kept in adjacent rooms and all the Mass Spectrometers are kept in close proximity. This year different rooms of the CIF unit are extensively renovated and this will provide better logistics for service to the researchers.

Under Science dissemination and popularization Scheme by CSIR-IICB the CIF is taking care of extending all sorts of support to the recipient students and faculties. The instrument facility was showcased to many students came from colleges and Universities on several occasions and these instruments include NMR, LCMS, AFM, XRD, FACS etc.

ANIMAL HOUSE

Dr. A. Konar (Head), Mr. S.S. Verma, Mr. A. Das, Mr. R. Sarkar, Mr. A. Sardar, Mr. J. Midya, Mr. P. Midya, Mr. T. Sarkar, Mr. Lalu Sardar, Mr. G. Sardar and Mr. S. Midya

The animal facility in IICB is a cpcsea registered (Registration No 147/GO/ReBi/S/99/CPCSEA) key-source for supply of authentic animals used in biomedical research programs of the Institute. All (animals) but a few special strain of mouse, are bred and supplied from the in-house breeding colony. Moreover, some other research institutes who have their CPCSEA registration also collect animals from the surplus stock of the facility for their IAEC approved research projects.

The animals are produced and kept in a scientifically maintained environment (Room Temp. 24, 20C; relative humidity 55 – 60%; light and dark schedule 12:12hrs; illumination 400 lux at 1 mt above the floor). They are raised under strict health and genetic monitoring. The house keeping of the facility acclaimed high appreciation not only from the associated scientists but also the representatives of CPCSEA, representative of different NGOs and private entrepreneurs, visiting guests and scientists.

Animals (specially mouse) were purchased from other registered breeders only when the required strain was not available in the colony or when animals of same specification was required in a bulk. However, proper utilization of animals was strictly monitored and animals were produced in such a number, that the number of unutilized animals be minimum but the scientists get their animals as and when they require.

The species and strains of animals, routinely maintained in the facility are as follows:

Mice - Balb/C, C57BL/6J, Rat - Sprague Dwalley, Hamster - Golden, Guinea Pig - English,

Rabbit - New Zealand White.

A brief account of animal produced/supplied from the animal house in during this period is given in the following table :

Species	Stock on 1st April 2016	No. of animals		Total (A)	No. of animals issued		No. of animals		Total (B)	Stock on 31.3. 2017
		Produced	Purchased		Produced	Purchased	died in-sto65ck	Supplied to other R&D organization		
Mouse	1702	4210	79	5991	3560	30	0	0	3590	2401
Rat	502	2276	180	2968	1926	180	0	0	2106	852
Hamster	336		0	336	41	0	50	0	91	245
Rabbit	109		0	109	21	0	0	0	21	88
Guinea pig	05	0	0	05	0	0	5	0	0	00

Engineering Services Unit (ESU)

Dr. Rupak K. Bhadra, (Head)

Civil Engineering	Electrical Engineering	Air-conditioning Refrigeration
Sandip Saha	Chirantan Debdas	Prasenjit Ganguly
Susanta Ray	Sourin Ghosh	Shubhendu Ghosh
Nirali Bage	Ujjal Roy	Sanjib Biswas
Debasish Banik	Saheb Ram Tudu	Prabir Das
Avijit Paul	Abhijit Paul	Sunil Nath
Shyamal K Ghosal	Samir Majumder	Manoranjan Adhikary
	Anup Karmakar	Bimal Das
.	Tonmay Biswas	

ACTIVITIES OF ENGINEERING SERVICES UNIT (ESU)

Engineering Service Unit (ESU) is comprised of Civil Engineering, Electrical Engineering and Air-conditioning and Refrigeration Sections and their activities in brief are given below.

Electrical Engineering Section

The Electrical Section provides all necessary services required for R&D and associated activities of the Institute as mentioned below:

- Providing Electrical power throughout the institute round the clock.
- Service and maintenance of Electrical and associated systems.
- Effective utilization of Electrical power and to make the installed systems Energy efficient.
- Modernization of Electrical power supply systems of laboratories and other functional areas of the Institute.
- Estimation, Planning, Execution and Monitoring of Engineering works related to Electrical and associated systems.

Apart from above services the division is also engaged in Electrical Power Monitoring system and Energy economy as described below.

Different scientific devices are very much sensitive to variation in certain Electrical parameters viz. supply voltage, wave forms, presence of harmonic components etc. To keep various Electrical parameters within their desired ranges and to bring economy in electricity consumption bills continuous Monitoring & Recording of different Electrical parameters viz. Voltage, Current, Power Factor and Total Harmonic Distortion etc. are of important considerations. Presently one Power Monitoring Unit along with associated systems is in operation at Electrical Substation of CSIR-IICB Jadavpur campus. During the financial year 2016-2017, to have instant Electrical data from Electrical Power Panels of Substation at CSIR-IICB Salt Lake campus, the capacity and features of previously installed Power Monitoring System of CSIR-IICB Jadavpur campus has been upgraded. An arrangement is there to transmit the Digital Data from the Electrical Panels IICB Salt Lake campus to the Main Power Monitoring Unit at Jadavpur campus using the existing IT infra-structure of CSIR-IICB, Here no additional expenditure has been incurred. On installation of this IP based Intelligent Power Monitoring System, major Electrical Panels of both the Institute campuses are 'virtually located at one place'. By means of this Digital system, it is possible to know the operating status of different Electrical Panels located either of the Institute campuses using Smart Phones/Tab etc. In case of occurrence of any major Electrical fault, the said Power Monitoring System is able to send "Text Massages (SMS)" automatically to the pre-assigned mobile numbers, so that appropriate measures can be taken immediately.

CSIR-IICB Electrical Engineering Section initiated different actions towards energy economy and Energy Conservation. Conventional type Lighting fixtures are replaced by modern energy efficient lighting fittings (LEDs) at both the Institute campuses. Various types of Time Switches, Relays, and Sensors have been installed and utilized for the purpose of "Automation" of existing Electrical and Electro-mechanical systems. Electrical Engineering Section of the Institute is giving their full effort for significant reduction in electricity consumption bill amount by taking various measures. During the last financial year the total electricity consumption bill amount was about Rs. 30 Lacs less compared to the bill amount of the same time period of the previous financial year. Further efforts will be given for the reduction of electricity consumption bills of both the campuses.

Civil Engineering Section

The Civil Engineering Section renders services in broad areas of infrastructure development, new construction, renovation and up-gradation of laboratories and common facilities, maintenance of campus, water supply, sewerage and drainage systems at both the campuses at Jadavpur as well as Salt Lake.

Air-conditioning and Refrigeration Section

The Air-conditioning and Refrigeration Section provides all the necessary services related to maintenance of air-conditioning systems of both the Jadavpur and Salt Lake campuses round the clock.

Administration

General Administration

Finance & Accounts Stores & Purchase Official Language Activities of the Institute. Awide range of functions are carried out by General Administration which cater to the life cycle of an Officer of the Scientific, Administrative and Technical Cadre encompassing manpower planning, cadre management, recruitment, role definition / allocation, skill assessment, workplace learning, career advancement, transfer, employee benefits, retirement, performance assessment etc. In addition Administration is also responsible for arrangement of all logistics and managing the day to day affairs of the Institute.

Finance & Accounts

This wing of administration is mainly concerned with keeping record of budgetary requirements, controlling & monitoring the expenditure and preparing budget for the Institute regarding plan & nonplan expenditure, which is about Rs. 90 crores per annum. Keeping track of progressive expenditure of budget for every month, keeping financial records for Networked Projects, externally funded projects, disbursement of pension to pensioners, accounting and auditing files routed through Establishment, Purchase and other scientific divisions. To Seek grant from outside bodies, i.e. UGC, ICMR, DBT etc., monthly remittance of P. Tax, I. Tax, Service Tax, etc. and incorporating entire vouchers of the Institute in administrative software. Through this entry, our Annual Accounts and Balance Sheet is generated for onward transmission to CSIR,HQ.

Stores & Purchase

The Stores & Purchase Division caters to the research and other requirement of CSIR-IICB. The annual procurement budget of CSIR-IICB is about Rs. 29 crores annually comprising of research consumables like chemicals, glass wares, plastic wares etc and various capital items. After successful implementation of online procurement and stores systems since 2007, the division had introduced web based ordering system from last year and continued successfully in the reporting year for Sigma products, Vendor Managed Inventoryprogram, stock of consumable of companies like Fisher, SRL, Spectrochem, Merck, RFCL, JT Baker, Tarson, Axygen, Fermenta, Thermo, BD falcon, Invitrogen, Takara-clontech, MN, Gilson & Eppendorf Pipettes, Computer cartridges of HP, Corning and so on. The division assists scientists and other users to utilize their budget grant within the project deadlines. The division also undertakes the issue of total logistic chain of items from anywhere in the world to CSIR-IICB that are either purchased by CSIR-IICB or being sent as free gifts or samples. It also undertakes customs clearance with concessional customs duty within demurrage free clearing time from Kolkata Airport and Sea port. Adjustment of OB, replies to audit and other statutory authorities, assistance to accounts for bank re-conciliation are other activities performed by the division.

Finance & Accounts

Stores & Purchase

OFFICIAL LANGUAGE (HINDI)

Rajbhasha implementation in the Institute goes on throughout the year. The year 2016-17 saw four workshops organized in the Institute. There were four Official Language meetings held in the Institute under the chairmanship of the Director.

Hindi week was observed in IICB from 7th to 14th September, 2016, 14th September being the Hindi Day. On this day many programmes were arranged under the chairmanship of the Director Dr. Samit Chattopadhyay. The Director welcomed all the members in his inaugural speech. The Chief Guest of the programme Professor Jagdishwar Chaturvedi of the Hindi Department Calcutta University, an eminent author, imparted an enlightened lecture on Hindi Language and he spoke about the regional languages especially Rajbhasha Hindi to be cultivated among the staff members. He requested the employees to write atleast two letters in a week in Hindi and abide by the Rajbhasha laws of the government. The Guest of Honor of the day was Dr. Geeta Dubey, Head of Hindi Department of Scottish Church College. Both the guests gave their views and appreciated the Hindi activities of the Institute. The Hindi Patrika Sanjeevani was released by the Director Dr. Samit Chattopadhyay. Scientific and many miscellaneous write ups from scientists and employees find place in Sanjeevani.

Hindi Week started from 7th September 2016 with various competitions in Hindi. The Director inaugurated the competition with a welcome speech. 25 employees and research fellows participated in this competition and Mr. P. Paliwal with our scientist Sri Anil Kumar were the judges of these competitions. On 8th September Noting, Drafting and Essay Competitions in Hindi were held where 35 employees and research fellows took part.

On 9th September a one-day Hindi Workshop was held by Sri Naveen Prajapati, Manager (Rajbhasa) DVC who gave a presentation on “Information Technology in Rajbhasa and its challenges)”. 34 Administrative employees took part in this workshop.

On 12th September there was a Recitation and Debate Competition in Hindi in the Institute and many employees and research fellows took part in the competitions. Sri Jitendra Jitanshu, the Editor of Hindi Patrika Sadinama and scientist of our Insitute Dr. Umesh Prasad Singh were the judges of the events.

The prizes of the competitions of Hindi Week were awarded to the winners on the 14th September.

The Hindi Day ended with a drama enacted by the Research Scholars of the Institute. The programme came to an end with the vote of thanks by the Administrative Officer Shri B.C. Sahoo. Other than these programmes regular workshops are held in the Institute.

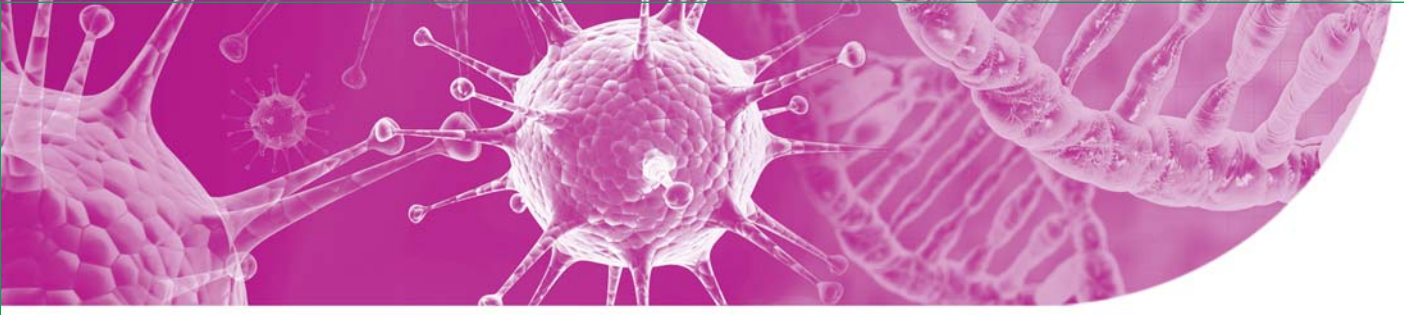
The workshops dated 15th June, 2016, 9th September, 2016, 30th December, 2016 and 27th March, 2017 qualify the staffs to work efficiently in the Official Language in computers with the help of Unicode mode of functionary.

Annual report of the institute was published in Rajbhasha in compliance with the Official Language policy of the government.

Publication Highlights

Sl. No.	Publications 2016	IF
1.	Bose M. and Bhattacharyya S.N. (2016) Target-dependent biogenesis of cognate microRNAs in human cells. *Nat Commun* **7,** 12200	12.124
2.	Mahata T., Kanungo A., Ganguly S., Modugula E. K., Choudhury S., Pal S.K., Basu G. and Dutta S. (2016) The benzyl moiety in a quinoxaline-based scaffold acts as a DNA Intercalation switch. *Angew Chem Int Ed Engl* **55**, 7733-773	11.994
3.	Ghosh A.R., Bhattacharya R., Bhattacharya S., Nargis T., Rahaman O., Duttagupta P., Raychaudhuri D., Liu C.S., Roy, S., Ghosh P., Khanna S., Chaudhuri T., Tantia O., Haak S., Bandyopadhyay S., Mukhopadhyay S., Chakrabarti P. and Ganguly D. (2016) Adipose recruitment and activation of plasmacytoid dendritic cells fuel metaflammation. *Diabetes* **65,** 3440-3452	8.684
4.	Ghosh M., Niyogi S., Bhattacharyya M., Adak M., Nayak D.K., Chakrabarti S. and Chakrabarti P. (2016) Ubiquitin ligase COP1 controls hepatic fat metabolism by targeting ATGL for degradation. *Diabetes* **65,** 3561-3572	8.684
5.	Mukherjee K., Ghoshal B., Ghosh S., Chakrabarty Y., Shwetha S., Das S. and Bhattacharyya S.N. (2016) Reversible HuR-microRNA binding controls extracellular export of miR-122 and augments stress response. *EMBO Rep* **17,** 1184-1203	8.568
6.	Alam S.K., Yadav V.K., Bajaj S., Datta A., Dutta S.K., Bhattacharyya M., Bhattacharya S., Debnath S., Roy S., Boardman L.A., Smyrk T.C., Molina J.R., Chakrabarti S., Chowdhury S., Mukhopadhyay D. and Roychoudhury S. (2016) DNA damage-induced ephrin-B2 reverse signaling promotes chemoresistance and drives EMT in colorectal carcinoma harboring mutant p53. *Cell Death Differ* **23,** 707-722	8.339
7.	Gupta P., Srivastav S., Saha S., Das P.K. and Ukil A. (2016) Leishmania donovani inhibits macrophage apoptosis and pro-inflammatory response through AKT-mediated regulation of beta-catenin and FOXO-1. *Cell Death Differ* **23,** 1815-1826	8.339
8.	Imamura H., Downing T., Van den Broeck F., Sanders M.J., Rijal S., Sundar S., Mannaert A., Vanaerschot M., Berg M., De Muylder G., Dumetz F., Cuypers B., Maes I., Domagalska M., Decuypere S., Rai K., Uranw S., Bhattara, N.R., Khanal B., Prajapati V.K., Sharma S., Stark O., Schonian G., De Koning H.P., Settimo L., Vanhollebeke B., Roy S., Ostyn B., Boelaert M., Maes L., Berriman M., Dujardin J.C. and Cotton J.A. (2016) Evolutionary genomics of epidemic visceral leishmaniasis in the Indian subcontinent. *Elife* **5,** e12613	7.725
9.	Ghosh S., Mohapatra S., Thomas A., Bhunia D., Saha A., Das G. and Jana B and Ghosh, S. (2016) Apoferritin nanocage delivers combination of microtubule and nucleus targeting anticancer drugs. *ACS Appl Mater Interfaces* **8,** 30824-30832	7.504
10.	Jana B., Mohapatra S., Mondal P., Barman S., Pradhan K., Saha A. and Ghosh, S. (2016) a-Cyclodextrin interacts close to vinblastine site of tubulin and delivers curcumin preferentially to the tubulin surface of cancer cell. *ACS Appl Mater Interfaces* **8,** 13793-13803	7.504
11.	Samanta J. and Natarajan R. (2016) Cofacial organic click cage to intercalate polycyclic aromatic hydrocarbons. *Org Lett* **18,** 3394-3397	6.579
12.	Chatterjee B., Banoth B., Mukherjee T., Taye N., Vijayaragavan B., Chattopadhyay S., Gomes J. and Basak S. (2016) Late-phase synthesis of IkappaBalpha insulates the TLR4-activated canonical NF-kappaB pathway from noncanonical NF-kappaB signaling in macrophages. *Sci Signal* **9,** ra120	6.494
13.	Yu J., Meng Z., Liang W., Behera S., Kudla J., Tucker M.R., Luo Z., Chen M., Xu D., Zhao G., Wang J., Zhang S., Kim Y.J. and Zhang D. (2016) A rice Ca2+ binding protein is required for tapetum function and pollen formation. *Plant Physiol* **172,** 1772-1786	6.456
14.	A. A. H., Ali F., Kushwaha S., Taye N., Chattopadhyay S. and Das A. (2016) A cysteine-specific fluorescent switch for monitoring oxidative stress and quantification of aminoacylase-1 in blood serum. *Anal Chem* **88,** 12161-12168	6.32
15.	Adak A., Mohapatra S., Mondal P., Jana B. and Ghosh S. (2016) Design of a novel microtubule targeted peptide vesicle for delivering different anticancer drugs. *Chem Commun (Camb)* **52,** 7549-7552	6.319
16.	Ali F., A A. H., Taye N., Mogare D.G., Chattopadhyay S. and Das A. (2016) Specific receptor for hydrazine: mapping the in situ release of hydrazine in live cells and in an in vitro enzymatic assay. *Chem Commun (Camb)*. **52,** 6166-6169	6.319
17.	Banerjee I., De K., Mukherjee D., Dey G., Chattopadhyay S., Mukherjee M., Mandal M., Bandyopadhyay A.K., Gupta A., Ganguly S. and Misra M. (2016) Paclitaxel-loaded solid lipid nanoparticles modified with Tyr-3-octreotide for enhanced anti-angiogenic and anti-glioma therapy. *Acta Biomater* **38,** 69-81	6.319

Sl. No.	Publications 2016	IF
18.	Basu K., Baral A., Basak S., Dehsorkhi A., Nanda J., Bhunia D., Ghosh S., Castelletto V., Hamley I.W. and Banerjee A. (2016) Peptide based hydrogels for cancer drug release: modulation of stiffness, drug release and proteolytic stability of hydrogels by incorporating D-amino acid residue(s). *Chem Commun (Camb)* **52,** 5045-5048	6.319
19.	Bhunia D., Mohapatra S., Kurkute P., Ghosh S., Jana B., Mondal P., Saha A. and Das G. (2016) Novel tubulin-targeted cell penetrating antimitotic octapeptide. *Chem Commun (Camb)* **52,** 12657-12660	6.319
20.	Ghosh M., Saha S. and Dutta S.K. (2016) 'Dual hit' metabolic modulator LDCA selectively kills cancer cells by efficient competitive inhibition of LDH-A. *Chem Commun (Camb)* **52,** 2401-2404	6.319
21.	Bhattacharya S., Mukherjee O., Mukhopadhyay A.K. and Chowdhury R. (2016) A conserved Helicobacter pylori gene, HP0102, is induced upon contact with gastric cells and has multiple roles in pathogenicity. *J Infect Dis* **214,** 196-204	6.273
22.	Sengupta C., Mukherjee O. and Chowdhury R. (2016) Adherence to intestinal cells promotes biofilm formation in Vibrio cholerae. *J Infect Dis* **214,** 1571-1578	6.273
23.	Das M., Ghosh M. and Das S. (2016) Thyroid hormone-induced differentiation of astrocytes is associated with transcriptional upregulation of beta-arrestin-1 and beta-adrenergic receptor-mediated endosomal signaling. *Mol Neurobiol* **53,** 5178-5190	6.19
24.	Basu A. and Kumar G.S. (2016) Multispectroscopic and calorimetric studies on the binding of the food colorant tartrazine with human hemoglobin. *J Hazard Mater* **318,** 468-476	6.065
25.	Ghosh G. and Sen M. (2016) A New DNA Methyltransferase-histone deacetylase-kinase axis in innate immunity. *Mol Cell* **63,** 544-546	5.988
26.	Sahu B.P., Hazarika, H., Bharadwaj R., Loying P., Baishya R., Dash S. and Das M.K. (2016) Curcumin-docetaxel co-loaded nanosuspension for enhanced anti-breast cancer activity. *Expert Opin Drug Deliv* **13,** 1065-1074	5.657
27.	Mishra A., and Deb I. (2016) Palladium-catalyzed oxidative cyclization for the synthesis of indolyl/pyrrolyl 3-phosphonates. *Adv Syn Catalysis* **358,** 22672272	5.646
28.	Biswas D., Ghosh M., Kumar S. and Chakrabarti P. (2016) PPARalpha-ATGL pathway improves muscle mitochondrial metabolism: implication in aging. *FASEB J* **30,** 3822-3834	5.498
29.	Adhikari S., Ghosh A., Guria S., Sarkar S. and Sahana A. (2016) Naturally occurring thymol based fluorescent probes for detection of intracellular free Mg2+ ionf. *Sens Actuators B Chem* **236,** 512-519	5.401
30.	Banerji B., Bera S., Chatterjee S., Killi S.K., and Adhikary S. (2016) Regioselective synthesis of quinazolinone-phenanthridine-fused heteropolycycles by Pd-catalyzed direct intramolecular aerobic oxidative C-H amination from aromatic strained amides. *Chem Eur J* **22,** 3506-3512	5.317
31.	Bose D., Banerjee S., Das S., Chatterjee N. and Saha K.D. (2016) Heat killed attenuated leishmania induces apoptosis of HepG2 cells through ROS mediated p53 dependent mitochondrial pathway. *Cell Physiol Biochem* **38,** 1303-1318	5.104
32.	Agarwalla H., Mahajan P.S., Sahu D., Taye N., Ganguly B., Mhaske S.B., Chattopadhyay S. and Das A. (2016) A switch-on NIR probe for specific detection of Hg2+ ion in aqueous medium and in mitochondria. *Inorg Chem* **55,** 12052-12060	4.857
33.	Dar A.A., Shadab M., Khan S., Ali N. and Khan A.T. (2016) One-Pot Synthesis and evaluation of antileishmanial activities of functionalized S-Alkyl/Aryl Benzothiazole-2-carbothioate scaffold. *J Org Chem* **81,** 3149-3160	4.849
34.	Hossian A., Bhunia S.K. and Jana R. (2016) Substrate-dependent mechanistic divergence in decarboxylative heck reaction at room temperature. *J Org Chem* **81,** 2521-2533.	4.849
35.	Jash M., Das B. and Chowdhury C. (2016) One-Pot Access to benzo[a]carbazoles via palladium(II)-catalyzed hetero and carboannulations. *J Org Chem* **81,** 10987-10999	4.849
36.	Kundu P., Mondal A. and Chowdhury C. (2016) A Palladium-catalyzed method for the synthesis of 2-(alpha-styryl)-2,3-dihydroquinazolin-4-ones and 3-(alpha-styryl)-3,4-dihydro-1,2,4-benzothiadiazine-1,1-dioxide: access to 2-(alpha-Styryl)quinazolin-4(3H)-ones and 3-(alpha-Styryl)-1,2,4-benzothiadiazine-1,1-dioxides. *J Org Chem* **81,** 6596-6608	4.849



Sl. No.	Publications 2016	IF
37.	Mal K., Kaur A., Haque F. and Das I. (2015) PPh3.HBr-DMSO: A reagent system for diverse chemoselective transformations. *J Org Chem* **80,** 6400-6410	4.849
38.	Mishra A., Vats T.K. and Deb I. (2016) Ruthenium-catalyzed direct and selective C-H cyanation of N-(Hetero)aryl-7-azaindoles. *J Org Chem* **81,** 6525-653	4.849
39.	Singh B.K., Polley A. and Jana R. (2016) Copper(II)-mediated intermolecular C(sp(2))-H amination of benzamides with electron-rich anilines. *J Org Chem* **81,** 4295-4303	4.849
40.	Pal S., Ramu V., Taye N., Mogare D.G., Yeware A.M., Sarkar D., Reddy D.S., Chattopadhyay S. and Das A. (2016) GSH induced controlled release of levofloxacin from a purpose-built prodrug: Luminescence response for Probing the drug release in Escherichia coli and Staphylococcus aureus. *Bioconjug Chem* **27,** 2062-2070	4.818
41.	Ghosh A., Bhowmik A., Bhandary S., Putatunda S., Laskar A., Biswas A., Dolui S., Banerjee B., Khan R., Das N., Chakraborty A., Ghosh M.K. and Sen P.C. (2016) Formulation and antitumorigenic activities of nanoencapsulated nifetepimine: A promising approach in treating triple negative breast carcinoma. *Nanomedicine* **12,** 1973-1985	4.761
42.	Mondal M., Sengupta M. and Ray K. (2016) Functional assessment of tyrosinase variants identified in individuals with albinism is essential for unequivocal determination of genotype-to-phenotype correlation. *Br J Dermatol* **175,** 1232-1242	4.706
43.	Jaiswal S.R., Chakrabarti A., Chatterjee S., Bhargava S., Ray K., O'Donnell P. and Chakrabarti S. (2016) Haploidentical peripheral blood stem cell transplantation with post-transplantation cyclophosphamide in children with advanced acute leukemia with fludarabine, busulfan, and melphalan-based conditioning. *Biol Blood Marrow Transplant* **22,** 499-504	4.704
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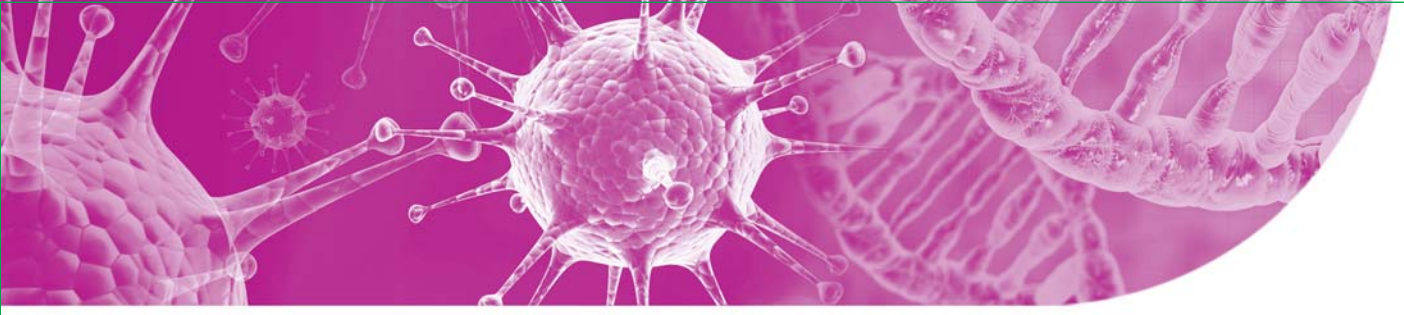

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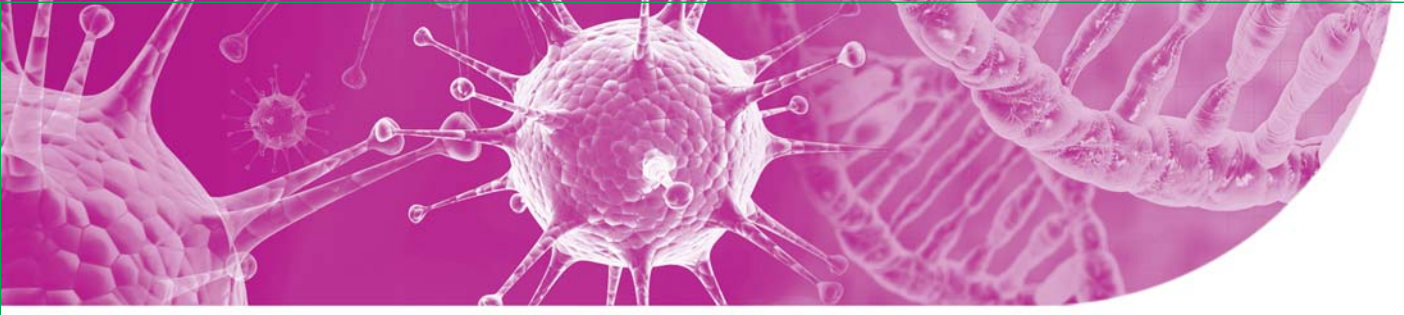

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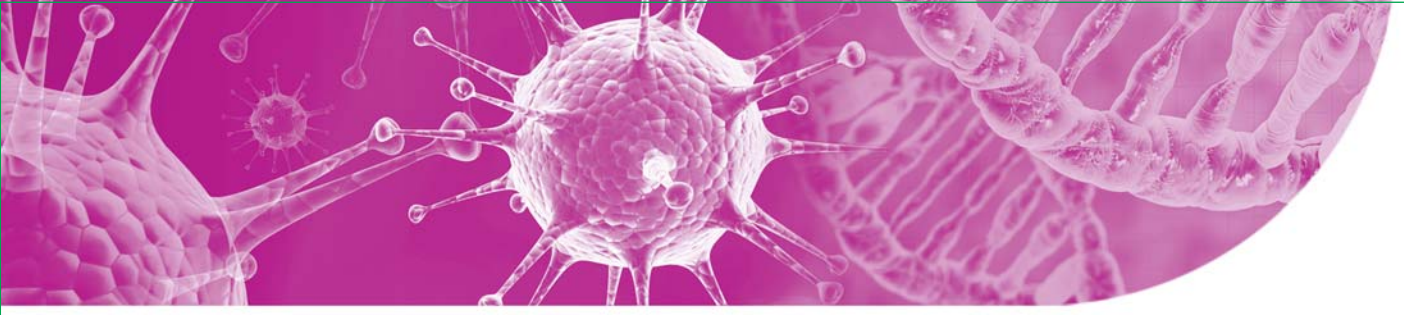

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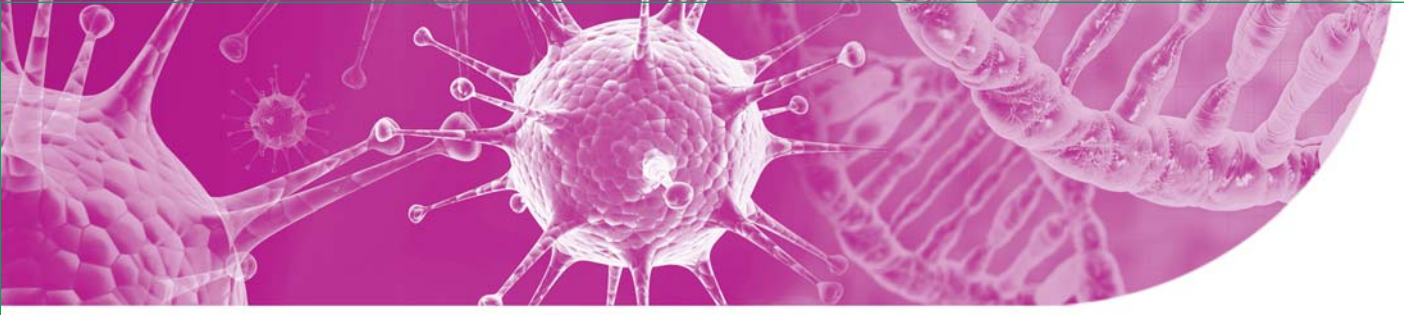

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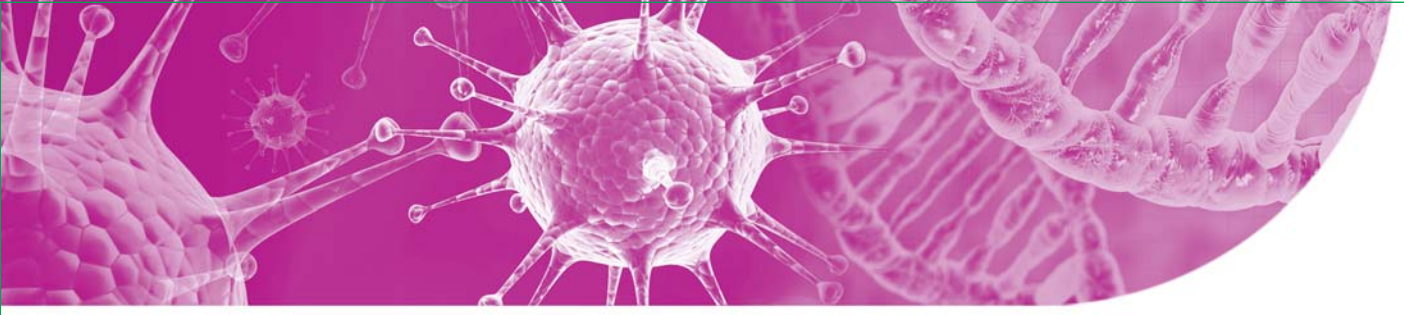

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235.	Sarkar A., Bhowmik T., Gomes A. and Gomes A. (2016) Apoptosis induced by a purified fraction (VB-P4) of the fresh water snail viviparous bengalensis flesh extract on osteoarthritic fibroblast like synoviocyte cells. *Lett Drug Design Discovery* **13,** 638-645	1.17
236.	Pal U., Pramanik S.K., Bhattacharya B., Banerji B. and Maiti N.C. (2016) Binding interaction of a gamma-aminobutyric acid derivative with serum albumin: an insight by fluorescence and molecular modeling analysis. *Springerplus* **5,** 1121	1.13
237.	Bhattacharya R., Mukherjee N., Dasgupta H., Islam M.S., Alam N., Roy A., Das P., Roychoudhury S. and Panda C.K. (2016) Frequent alterations of SLIT2-ROBO1-CDC42 signalling pathway in breast cancer: clinicopathological correlation. *J Genet* **95,** 551-563	0.995
238.	Kaurani L., Vishal M., Ray J., Sen A., Ray K. and Mukhopadhyay A. (2016) TBK1 duplication is found in normal tension and not in high tension glaucoma patients of Indian origin. *J Genet* **95,** 459-461	0.995
239.	Ghosh J., Panja S.K., Maiti S., Biswas P., Sarkar T. and Bandyopadhyay C. (2016) Synthesis of 3-aminomethylidenechroman-2-carboxamides by a sequential one-pot three component reaction and by post-passerini condensation modification. *J Heterocyclic Chem* **53,** 449-456	0.893
240.	Narayanan R. and Bhattacharyya S.N. (2016) Biological sciences. *Curr Sci* **111,** 1897-1897	0.843
241.	Sharma K. and Bhattacharyya D. (2016) Application of transverse urea gradient zymography for structural and functional characterization of proteolytic enzymes. *Curr Sci.* **111,** 1340-1348	0.843
242.	Chatterjee N., Sanphui P., Kemeny S., Greene L.A. and Biswas S.C. (2016). Role and regulation of Cdc25A phosphatase in neuron death induced by NGF deprivation or β-amyloid. *Cell Death Discovery* **2,**16083	Nil
243.	Das P., Jain C.K., Roychoudhury S., Majumder H. K., Das S. (2016) Design, synthesis and in vitro anticancer activity of a Cu(II) complex of carminic acid: A novel small molecule inhibitor of human DNA Topoisomerase I and Topoisomerase II. *Chemistry Select* **1,** 6623-6631	Nil
244.	Gania A., Bhadra R., Chattoraj D.K., Mukherjee D.C. and Mitra A. (2016) Thermodynamics of excess binding of inorganic salts and organic solutes to crab hemocyanin *J Indian Chem Society* **93** 553-561	Nil
245.	Ghosh C., Bhunia D., Ghosh S., Jana B., Ghosh S. and Bhattacharyya K. (2016) Fluorescence probing of fluctuating microtubule using a covalent fluorescent probe: Effect of taxol. *Chemistry Select* **1,** 1841-1847	Nil
246.	Karmakar A., Maitra S., Chakraborti B., Verma D., Sinha S., Mohanakumar K.P., Rajamma U. and Mukhopadhyay K. (2016) Monoamine oxidase B gene variants associated with attention deficit hyperactivity disorder in the Indo-Caucasoid population from West Bengal. *BMC Genet* **17,** 92	Nil
247.	Ray S., Roy P.K. and Majumder A. (2016) Quality of packaged drinking water in Kolkata City, India and risk to public health. *Desalination Water Treatment* **57,** 28734-28742	Nil
248.	Shankar Sudha; Wani Naiem Ahmad and Singh Umesh Prasad; et al. (2016) Incipient twisted ribbon structure stabilized by C-12 helical turns in gamma(4)/alpha hybrid peptide. *Chemistry Select* **1,** 3675-3678	Nil
249.	Wani N.A., Gupta V.K., Singh U.P., Aravinda S. and Rai R. (2016) Folded structure stabilized by C7, C10 and C12 hydrogen bonds in á/ã hybrid peptides. *Chemistry Select* **1,** 1674 1677	Nil
250.	Yadav D.K., Bharitkar Y.P., Chatterjee K., Ghosh M., Mondal N.B., and Swarnakar S. (2016) Importance of Neem leaf: An insight into its role in combating diseases Indian *J Exptl Biol* **54,** 708-718	Nil

Doctorates From CSIR-IICB

Sl. No.	Recipient's Name	Title of the Thesis	University	Date of Award	Supervisor's Name	Division
1.	Arpita Bhoumik	Correlation of vertical velocity of spermatozoa with fertility potential and evaluation of physiological significance of sperm motility regulatory factors	Calcutta	27/10/2016	Dr. Sandhya Rekha Dungdung	CBP
2.	Arijit Bhowmik	Regulation of EGFR signaling network by novel molecules for cancer therapy	Calcutta	2016-2017	Dr. Mrinal K. Ghosh	CBID
3.	Moumita Sarkar	Role and regulation of RNA Helicase p68 in cancer	Calcutta	2016-2017	Dr. Mrinal K. Ghosh	CBID
4.	Raghavendra Singh	Molecular basis of neuroprotection against perkinsonism by identified ayurvedic molecules.	Calcutta	11/02/2017	Dr. K.P. Mohanakumar & Dr. Parasuraman Jaisankar	OMC
5.	Rinku Baishya	99mTc labeled Radiopharmaceuticals for Tumor Imaging	Jadavpur	16/02/2016	Dr. Mita Chatterjee Debnath	IDID
6.	Sayantan Jana	Studies on the role of matrix metalloproteinases and their inhibitors in the pathogenesis of endometriosis	Calcutta	23/02/2017	Dr. Snehasikta Swarnakar	CBID
7.	Kousik Kumar Kesh	Genetic and epigenetic signature of matrix metalloproteinase and tissue inhibitor of metalloproteinases and their association with risk of gastric carcinoma	Jadavpur	March2016	Dr. Snehasikta Swarnakar	CBID
8.	Sourav Saha	DNA Topoisomerase(s) of Leishmania donovani And Development of Inhibitors With Potent Antileishmanial Activities	Calcutta	27/12/2016	Dr. H.K. Majumder (PI) & Dr. Partha Chakrabarti (CoPI)	IDID
9.	Shreya Dasgupta	'Molecular studies on stringent response gene relV of Vibrio cholerae'	Calcutta	15/06/2016	Dr. Rupak K. Bhadra, Chief Scientist	IDID
10.	Rammyani Pal	Synthetic studies on oligosaccharides, carbohydrate containing triazoles and N-based heterocycles of biological importance	Calcutta	20/06/2016	Dr. Asish Kumar Sen (Co-guide: Dr. P.J. Jaisankar)	OMC
11.	Nivedita Chatterjee	Synthetic studies on fused N/O-based heterocycles and sugar containing heterocyclic molecules of biological importance	Calcutta	07/09/2017	Dr. Asish Kumar Sen (Co-guide: Dr. P. Jaisankar)	OMC
12.	Pradyot Bhattacharya	Investigations on Immunomodulatory and Parasiticidal Efficacies of Individualistic and Combinatorial Chemotherapeutic Agents against Visceral Leishmaniasis	Calcutta	25/10/2016	Dr. Nahid Ali	IDID

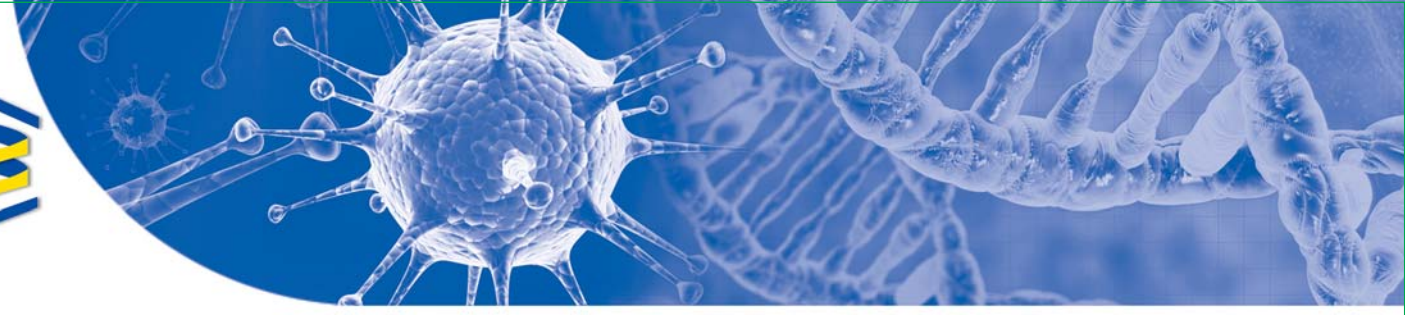
Doctorates From CSIR-IICB

Sl. No.	Recipient's Name	Title of the Thesis	University	Date of Award	Supervisor's Name	Division
13.	Mithun Maji	Immunostimulation of antigen presenting cells by differentially charged liposomes	Calcutta	30/11/2016	Dr. Nahid Ali	IDID
14.	Poornima Chandran	Insight into the embryo –uterus moliecular cross talk in the process of implantation : a study using uterine specific stat-3 knockout mice model ?	Jadavpur	2013	Dr. S.N. Kabir	CBP
15.	Sudarshan Bhattacharjee	Molecular and Biochemical Studies of Mitochondrial Dysfunction in Insulin Resistance and Type 2 Diabetes?	Calcutta	23/11/ 2016	Dr. Sib Sankar Roy	CBP
16.	Prarthana Thakurta	Investigation of biological activity of phenolic glycosides isolated from heart--wood of Pterocarpus marsupium Roxb.	Jadavpur	2016	Dr. S.N. Kabir Dr. Sib Sankar Roy	CBP
17.	Moitreyi Das	Studies on functional role of docosahexaenoic acid (DHA) in the brain	Calcutta	22/08/2016	Dr. Sumantra Das	CBP
18.	Abhijit Saha	Reconstitution Of Alzheimer Disease Propagation Pathway Using Aâ Peptide And Its Link With Cancer	Calcutta	08/11/2016	Dr. Surajit Ghosh	OMC
19.	Batakrishna Jana	Development Of Functionalised Nanomaterials For Delivery Of Multiple Biomolecules Into The Cell	Calcutta	16/11/2016	Dr. Surajit Ghosh	OMC
20.	Aparupa Bose Mazumdar	"Molecular study and in-depth transcriptome analysis of Phyllanthus amarus leaves identifying lignans and other secondary metabolites biosynthetic pathway gene/s"	Jadavpur	31/01/2017	Dr. Sharmila Chattopadhyay	OMC
21.	Somi Patranabis	Role of miRNAs and RNA Processing Body Components in Controlling Death and dfferentiation of Mammalian	Calcutta	01/03/2017	Dr. Suvendra N. Bhattacharyya	MG
22.	Bahnisikha Barman	Neuronal Cells Subcellular compartmentalization of translation machineries in mammalian cells and its implication in gene expression regulation	Calcutta	07/03/2017	Dr. Suvendra N. Bhattacharyya	MG
23.	Soumitra Hazra	Biophysical studies on the interaction of natural alkaloids with heme proteins	Calcutta	01/10/2017	Dr. G. Suresh Kumar	OMC

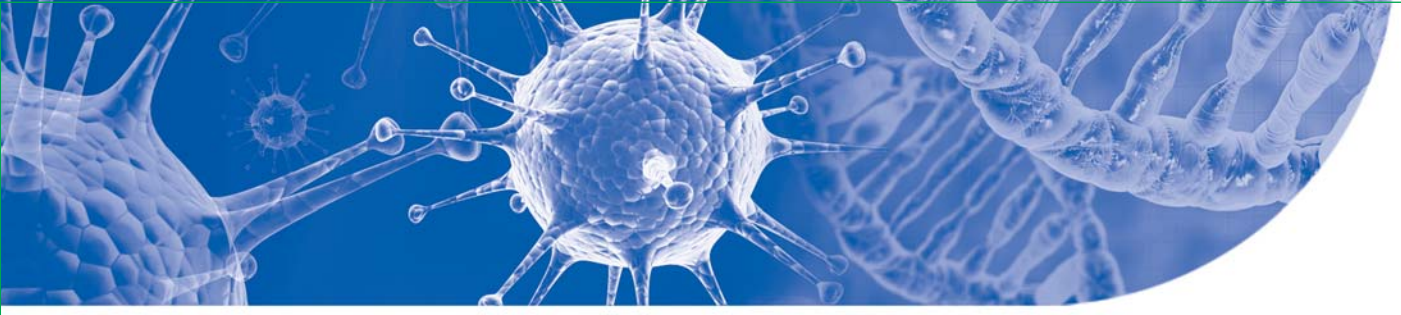
STAFF LIST AS ON 31st March, 2017

Director	1
Scientist – Gr. IV	46
Technical – Gr. III	46
Technician – Gr. II	33
Helper Gr. I	15
Officers in Administration	11
Administrative Staff	38
Gr. C (Non-Technical)	12
Canteen Staff	7
TOTAL	**209**

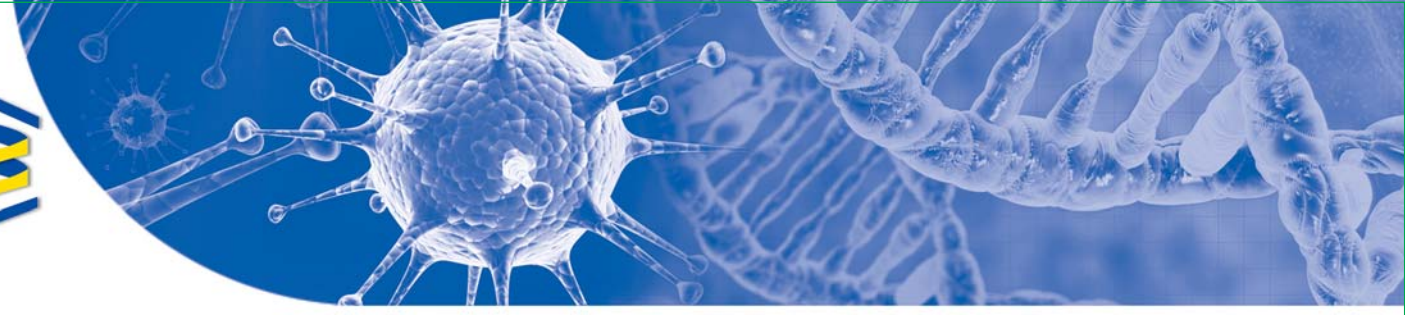
	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
1	1	**592**	**Samit Chattopadhyay Dr.**	**Director**	**HAG 67000-79000/**	
2	1	105	G. Suresh Kumar Dr.	Chief Scientist	PB-4 37400-67000/-	10,000/-
3	2	115	R. Chowdhury Dr. (Mrs.)	Chief Scientist	PB-4 37400-67000/-	10,000/-
4	3	124	Rupak Kr. Bhadra Dr.	Chief Scientist	PB-4 37400-67000/-	10,000/-
5	4	112	P. Jaisankar Dr.	Chief Scientist	PB-4 37400-67000/-	10,000/-
6	1	445	Arun Bandyopadhyay Dr.	**Senior Principal Scientist**	PB-4 37400-67000/-	8900/-
7	2	120	S. R. Dungdung Dr. (Mrs.)	Senior Principal Scientist	PB-4 37400-67000/-	8900/-
8	3	521	Uday Bandopadhyay Dr.	Senior Principal Scientist	PB-4 37400-67000/-	8900/-
9	4	473	S. Swarnakar Dr.(Miss)	Senior Principal Scientist	PB-4 37400-67000/-	8900/-
10	5	443	Sibsankar Ray Dr.	Senior Principal Scientist	PB-4 37400-67000/-	8900/-
11	1	110	M. Bhowmik Dr. (Miss)	**Principal Scientist**	PB-4 37400-67000/-	8700/-
12	2	99	Tushar K. Chakraborty Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
13	3	441	Aditya Konar Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
14	4	520	Chinmay Chowdhury Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
15	5	563	Rupasri Ain Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
16	6	570	Sucheta Tripathi Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
17	7	503	Soumen Datta Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
18	8	523	K.N. Chattopadhyay Dr	Principal Scientist	PB-4 37400-67000/-	8700/-
19	9	524	Mrinal Kanti Ghosh Dr	Principal Scientist	PB-4 37400-67000/-	8700/-
20	10	447	S. Chattopadhyay Dr.(Mrs)	Principal Scientist	PB-4 37400-67000/-	8700/-
21	11	472	Subrata Adak Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
22	12	530	S. N. Bhattacharya Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
23	13	122	N. V. M. Khalkho Mrs. Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
24	14	580	Saikat Chakrabarti Dr	Principal Scientist	PB-4 37400-67000/-	8700/-
25	15	581	Surajit Ghosh Dr	Principal Scientist	PB-4 37400-67000/-	8700/-
26	16	582	Debabrata Biswas Dr	Principal Scientist	PB-4 37400-67000/-	8700/-
27	17	584	Umesh Prasad Singh Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
28	18	527	Malini Sen Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
29	19	532	Jayati Sengupta Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
30	20	540	Biswadip Banerji Dr.	Principal Scientist	PB-4 37400-67000/-	8700/-
31	1	547	Subhas Ch. Biswas Dr.	**Senior Scientist**	PB-3 15600-39100/-	7600/-
32	2	551	Nakul Ch. Maiti Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
33	3	561	Partha Chakrabarti Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
34	4	566	Sanjoy Datta Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
35	5	568	Siddhartha Ray Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
36	6	571	Ranjan Jana Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
37	7	572	Arindam Talukdar Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
38	8	574	Ramalingam Natarajan Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
39	9	575	Sujoy Mukherjee Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
40	10	576	Indu Bhusan Deb Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
41	11	577	Dipyaman Ganguly Dr	Senior Scientist	PB-3 15600-39100/-	7600/-
42	12	578	Amitava Sengupta Dr	Senior Scientist	PB-3 15600-39100/-	7600/-



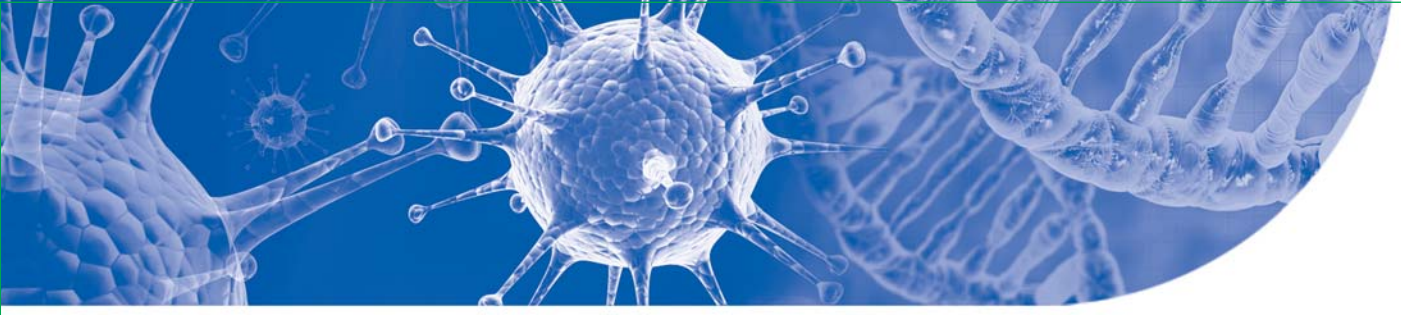
	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
43	13	583	Subhajit Biswas Dr.	Senior Scientist	PB-3 15600-39100/-	7600/-
44	1	528	Saraswati Garai Dr.	**Scientist**	PB-3 15600-39100/-	6600/-
45	2	560	Indrajit Das Dr.	Scientist	PB-3 15600-39100/-	6600/-
46	3	601	Anil Kumar Mr.	Scientist	PB-3 15600-39100/-	6600/-
47	4	605	G. Senthil Kumar Dr.	Scientist	PB-3 15600-39100/-	6600/-
48	1	143	Krishna Das Saha Mrs. Dr.	**Principal Technical Officer**	PB-4 37400-67000/-	8700/-
49	2	145	S.E. Besra Dr. (Mrs.)	Principal Technical Officer	PB-4 37400-67000/-	8700/-
50	3	432	M Chatterjee Debnath Dr.	Principal Technical Officer	PB-4 37400-67000/-	8700/-
51	4	164	S. Majumdar Dr.	Principal Technical Officer	PB-4 37400-67000/-	8700/-
52	5	467	Shekhar Ghosh Sri	Principal Technical Officer	PB-4 37400-67000/-	8700/-
53	6	494	Sandip Saha Sri	Sr. Superintending Engineer (Civil)	PB-4 37400-67000/-	8700/-
54	1	535	Chirantan Debdas Sri	Superintending Engineer (Electrical)	PB-3 15600-39100/-	7600/-
55	2	499	Narayan ch. Ghosh Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
56	3	448	Binayak Pal Sri	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
57	4	449	Aparna Laskar Mrs. Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
58	5	174	Sankar Kumar Maitra Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
59	6	175	Ardhendu Kr. Mandal Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
60	7	177	Tapas Sarkar Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
61	8	179	Subhagata Ghosh Miss Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
62	9	180	Arupesh Majumder Sri	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
63	10	185	R.N.Mandi Sri	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
64	11	184	Ramdhan Majhi Dr.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
65	12	187	Asish Mullick Sri	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
66	13	188	Dipika Roy Mrs.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
67	14	173	Purnima Chatterjee Mrs.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
68	15	176	Banasri Das Mrs.	Sr. Technical Officer (3)	PB-3 15600-39100/-	7600/-
69	1	186	P. Gangopadhyay Sri	Executive Engineer (Air Cond.)	PB-3 15600-39100/-	6600/-
70	2	178	Diptendu Bhattacharya Sri	Sr. Technical Officer (2)	PB-3 15600-39100/-	6600/-
71	3	182	Pratap Ch. Kayal Sri	Sr. Technical Officer (2)	PB-3 15600-39100/-	6600/-
72	4	496	E. Padmanaban Sri	Sr. Technical Officer (2)	PB-3 15600-39100/-	6600/-
73	5	162	Kshudiram Naskar Sri	Sr. Technical Officer (2)	PB-3 15600-39100/-	6600/-
74	6	514	Susanta Ray Sri	Executive Engineer (Civil)	PB-3 15600-39100/-	6600/-
75	1	411	Sandip Chowdhury Sri	**Sr. Technical Officer (1)**	PB-3 15600-39100/-	5400/-
76	1	463	Arti Grover Mrs.	**Technical Officer**	PB-2 9300-34800/-	4600/-
77	2	465	Swapan Kr. Mondal Sri	Technical Officer	PB-2 9300-34800/-	4600/-
78	3	495	Jishu Mandal Sri	Technical Officer	PB-2 9300-34800/-	4600/-
79	4	466	Nirali Bage Mrs.	Assistant Engineer (Civil)	PB-2 9300-34800/-	4600/-
80	5	513	Debashis Banik Sri	Assistant Engineer (Civil)	PB-2 9300-34800/-	4600/-
81	6	516	Sandip Chakraborty Sri	Technical Officer	PB-2 9300-34800/-	4600/-
82	7	604	Sounak Bhattacharya Sri	Technical Officer	PB-2 9300-34800/-	4600/-



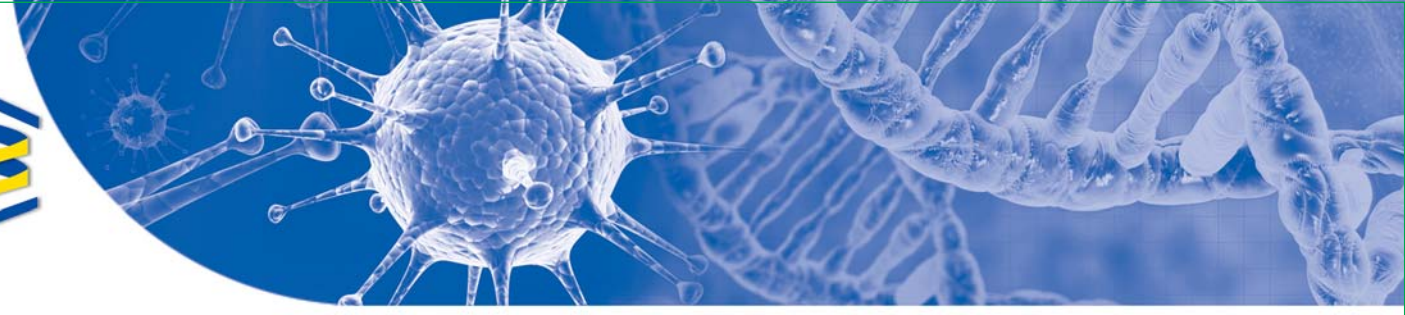
	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
83	1	539	Muruganandan T. Sri	**Technical Assistant**	PB-2 9300-34800/-	4200/-
84	2	550	Karri Suresh Kumar Sri	Technical Assistant	PB-2 9300-34800/-	4200/-
85	3	552	M. Vigneshwaran Sri	Technical Assistant	PB-2 9300-34800/-	4200/-
86	4	556	Santu Paul Sri	Technical Assistant	PB-2 9300-34800/-	4200/-
87	5	557	Sandip Kundu Sri	Technical Assistant	PB-2 9300-34800/-	4200/-
88	6	559	Debasree Das Ms	Technical Assistant	PB-2 9300-34800/-	4200/-
89	7	569	Pradeep Sypureddi	Technical Assistant	PB-2 9300-34800/-	4200/-
90	8	579	Soumik Laha Sri	Technical Assistant	PB-2 9300-34800/-	4200/-
91	9	589	Sourin Ghosh Sri	Junior Engineer (Electrical)	PB-2 9300-34800/-	4200/-
92	10	529	Ujjal Roy Sri	Junior Engineer (Electrical)	PB-2 9300-34800/-	4200/-
93	11	600	Shubhendu Ghosh Sri	Junior Engineer (Air Cond.)	PB-2 9300-34800/-	4200/-
94	1	241	S. C. Das Sri	**Sr. Technician (2)**	PB-2 9300-34800/-	4600/-
95	2	251	S. R. Tudu Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
96	3	244	Swapan Kumar Naskar Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
97	4	344	Ayub Shah Md.	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
98	5	242	Sheo Shankar Verma Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
99	6	246	Tapas Chowdhury Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
100	7	383	Pradip Mondal Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
101	8	247	Tarak Prasad Nandi Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
102	9	248	Sutapa Ganguly Mrs.	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
103	10	249	Sanjib Biswas Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
104	11	250	R. P. Gorh Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
105	12	252	Nishikanta Naskar Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
106	13	253	Pallab Mukherjee Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
107	14	345	Ranjit Das Sri	Sr. Technician (2)	PB-2 9300-34800/-	4600/-
108	1	450	Abhijit Paul Sri	**Sr. Technician (1)**	PB-2 9300-34800/-	4200/-
109	2	410	Anirban Manna Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
110	3	426	Samir Majumder Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
111	4	360	M. Ahmed Md.	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
112	5	409	Paresh Sarkar Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
113	6	416	Sujit Kr. Majumdar Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
114	7	419	Mahua Bhattacharjee Mrs.	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
115	8	418	Prabir Kr. Das Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
116	9	460	Tapan Das Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
117	10	417	Atanu Maitra Sri	Sr. Technician (1)	PB-2 9300-34800/-	4200/-
118	1	534	Anup Karmakar Sri	**Technician (1)**	PB-1 5200-20200/-	1900/-
119	2	546	Soumalya Sinha Sri	Technician (1)	PB-1 5200-20200/-	1900/-
120	3	553	Nita Chakraborty Ms	Technician (1)	PB-1 5200-20200/-	1900/-
121	4	554	Akash Gupta Sri	Technician (1)	PB-1 5200-20200/-	1900/-
122	5	555	Samir Thami Sri	Technician (1)	PB-1 5200-20200/-	1900/-
123	6	585	Avijit Paul Sri	Technician (1)	PB-1 5200-20200/-	1900/-
124	7	586	Tanmoy Biswas Sri	Technician (1)	PB-1 5200-20200/-	1900/-



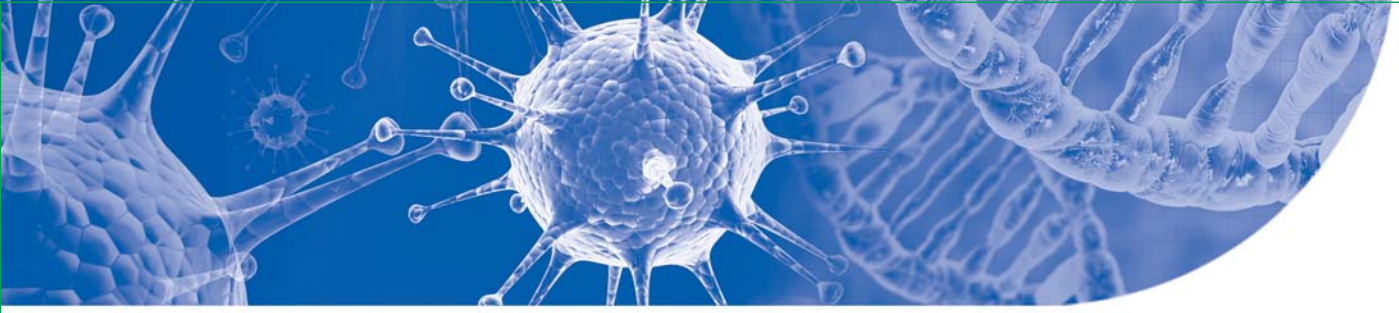
	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
125	8	590	Shiv Kumar Gupta Sri	Technician (1)	PB-1 5200-20200/-	1900/-
126	9	591	Hari Sankar Beni Shri	Technician (1)	PB-1 5200-20200/-	1900/-
127	1	272	Sunil Nath Sri	**Lab. Assistant**	PB-1 5200-20200/-	2800/-
128	2	274	R. N. Jana Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
129	3	275	Prahlad Das Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
130	4	440	Bhaskar Basu Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
131	5	279	Shyamal Das Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
132	6	479	Madan Halder Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
133	7	280	Amerika Das Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
134	8	282	Nimai Charan Prodhan Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
135	9	351	Sambhu Raul Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
136	10	353	Suresh Balmiki Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
137	11	361	S. K. Banik Sri	Lab. Assistant	PB-1 5200-20200/-	2800/-
138	1	352	Nanda Lal Routh Sri	**Lab. Attendant (2)**	PB-1 5200-20200/-	1900/-
139	2	501	Ashoke Sardar Sri	Lab. Attendant (2)	PB-1 5200-20200/-	1900/-
140	3	502	Ram Kumar Sarkar Sri	Lab. Attendant (2)	PB-1 5200-20200/-	1900/-
141	4	519	Shyamal Nath Sri	Lab. Attendant (2)	PB-1 5200-20200/-	1900/-
				Lab.Attendant (1)	PB-1 5200-20200/-	1800/-
				ADMINISTRATION		
142	1	606	Suprokash Halder Sri	Administrative Officer	PB-3 15600-39100/-	6600/-
143	2	573	Sudipto Chatterjee Sri	Finance & Accounts Officer	PB-3 15600-39100/-	7600/-
144	3	602	A.K. Pandey Sri	Stores & Purchase Officer	PB-3 15600-39100/-	6600/-
145	6	587	V.K. Gond Shri	Section Officer (G)	PB-3 15600-39100/-	5400/-
146	7	525	Shampoo Sengupta Mrs.	Section Officer (G)	PB-3 15600-39100/-	5400/-
147	8	308	Anjana Mandi Mrs.	Section Officer (G)	PB-2 9300-34800/-	4800/-
148	9	392	Kanu Mondal Sri.	Section Officer (G)	PB-2 9300-34800/-	5400/-
149	10	588	Monoj Kumar Sri	SO(F&A)	PB-3 15600-39100/-	5400/-
150	11	397	Ratan Bage Sri	SO(SP)	PB-3 15600-39100/-	5400/-
151	1	427	Sanhita Ganguly Mrs.	**ASSTT. (GEN.) GR.I**	PB-2 9300-34800/-	4800/-
152	2	428	M. Bhattacharya Mrs.	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4800/-
153	3	334	R.N. Hansda Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4800/-
154	4	335	Prem Singh Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4800/-
155	5	340	D. K. Kisku Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4600/-
156	6	396	Alok Ray Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4600/-
157	7	510	Jayanta Pal Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4600/-
158	8	511	Saugata Das Sri	ASSTT. (GEN.) GR.I	PB-2 9300-34800/-	4600/-
159	1	508	Tarun Kr. Sinha Roy Sri	**ASSTT. (G) GR.II**	PB- 1 5200-20200/-	2400/-
160	2	507	Raju Pal Sri	ASSTT. (G) GR.II	PB- 1 5200-20200/-	2400/-
161	3	509	Ranjit Debnath Sri	ASSTT. (G) GR.II	PB- 1 5200-20200/-	2400/-
162	4	512	Sukhendu Biswas Sri	ASSTT. (G) GR.II	PB- 1 5200-20200/-	2400/-
163	5	565	Anirudha Das Sri	ASSTT. (G) GR.II	PB- 1 5200-20200/-	2400/-
164	1	593	Tanumoy Sen Shri	**ASSTT. (G)GR.III**	PB- 1 5200-20200/-	1900/-



	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
165	2	594	Raju Kumar Shri	ASSTT. (G)GR.III	PB- 1 5200-20200/-	1900/-
166	3	595	Debtanu Pal Shri	ASSTT. (G)GR.III	PB- 1 5200-20200/-	1900/-
167	4	596	Sumit Kumar Singh Shri	ASSTT. (G)GR.III	PB- 1 5200-20200/-	1900/-
168	5	597	Ram Kanai Mondal Shri	ASSTT. (G)GR.III	PB- 1 5200-20200/-	1900/-
169	1	476	Banani Dutta Mrs.	**Asstt.(F&A),Gr.I**	PB-2 9300-34800/-	4800/-
170	2	343	Sanjoy Mukhopadhyay Sri	Asstt.(F&A),Gr.I	PB-2 9300-34800/-	4800/-
171	3	336	Asit Kr. Roy Sri	Asstt.(F&A),Gr.I	PB-2 9300-34800/-	4600/-
172	4	338	M. K. Dutta Sri	Asstt.(F&A),Gr.I	PB-2 9300-34800/-	4600/-
173	1	506	Vishal Agarwal Sri	**ASSTT. (F & A) GR.II**	PB-1 5200-20200/-	2400/-
174	1	598	Chaitali Sarkar Miss	**ASSTT. (F & A) GR.III**	PB-1 5200-20200/-	1900/-
175	1	328	A. B. S. Roy Sri	**ASSISTANT (SP) GR.I**	PB-2 9300-34800/-	4800/-
176	2	536	Rajib Ray Sri	ASSISTANT (SP) GR.I	PB-2 9300-34800/-	4600/-
177	3	342	Bisweswar Das Sri	ASSISTANT (SP) GR.I	PB-2 9300-34800/-	4600/-
178	4	363	Bula Pal Mrs.	ASSISTANT (SP) GR.I	PB-2 9300-34800/-	4600/-
179	1	505	Pradipta Sarkar Sri	**ASSISTANT (SP) GR.II**	PB-1 5200-20200/-	2400/-
180	2	504	Arnab Sen Sri	ASSISTANT (SP) GR.II	PB-1 5200-20200/-	2400/-
181	1	599	Shyama Chanran Bose	**ASSISTANT (SP) GR.III**	PB-1 5200-20200/-	1900/-
182	1	324	Pratima Banerjee Mrs.	**SR. STENOGRAPHER**	PB-2 9300-34800/-	4800/-
183	2	325	Shankar Bhakta Sri	SR. STENOGRAPHER	PB-2 9300-34800/-	4800/-
184	3	393	Rabindranath Das Sri	SR. STENOGRAPHER	PB-2 9300-34800/-	4800/-
185	4	490	Sankar Santra	SR. STENOGRAPHER	PB-2 9300-34800/-	4600/-
186	5	453	Gautam Saha Sri	SR. STENOGRAPHER	PB-2 9300-34800/-	4600/-
187	6	491	Moumita Majumdar Mrs.	SR. STENOGRAPHER	PB-2 9300-34800/-	4600/-
188	1	405	Saibal Giri Sri	**JR. STENOGRAPHER**	PB-1 5200-20200/-	2400/-
				ISOLATED POST		
189	1	321	Ambalika Nag Mrs.	Hindi officer	PB-2 9300-34800/-	5400/-
190	2	567	Sabyasachi Karmokar Sri	Security Officer	PB-2 9300-34800/-	4600/-
				Gr-C (NT)		
191	1	348	Ashok Ram Sri	GR-C (NT)	PB-1 5200-20200/-	2400/-
192	2	365	Kailash Ch. Nayak Sri	GR-C (NT)	PB-1 5200-20200/-	2000/-
193	3	401	Soma Devi Sharma Mrs	GR-C (NT)	PB-1 5200-20200/-	1900/-
194	4	412	Gopal Ch. Mandal Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
195	5	413	Asit Mitra Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
196	6	431	Janmanjoy Midya Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
197	7	430	Pasupati Midya Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
198	8	423	Shyamal Kr. Ghosal Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
199	9	414	P. C. Dehury Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
200	10	425	Manoranjan Adhikary Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
201	11	424	Tapan Sarkar Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-



	Sl. No.	EMP.ID	EMPLOYEE'S NAME	DEISGNATION	Revised Pay Band	Grade Pay
202	12	451	Dinesh Mahali Sri	GR-C (NT)	PB-1 5200-20200/-	1900/-
				Canteen		
203	1	373	Sudhangshu Halder Sri	TEA MAKER	PB-1 5200-20200/-	2400/-
204	2	372	Bimal Das Sri	BEARER	PB-1 5200-20200/-	2400/-
205	3	371	Ashok Sadhukhan Sri	BEARER	PB-1 5200-20200/-	2400/-
206	4	370	Badal Haldar Sri	BEARER	PB-1 5200-20200/-	2400/-
207	5	374	Jagabandhu Biswas Sri	WASH BOY	PB-1 5200-20200/-	2400/-
208	6	375	Nirapada Halder Sri	SWEEPER	PB-1 5200-20200/-	2000/-
209	7	376	Mantu Das Sri	SWEEPER	PB-1 5200-20200/-	2000/-



LIST OF EMERITUS SCIENTISTS AND OTHER PRESTIGIOUS FELLOWSHIP AWARDEES

Sl. No.	Name of the Emeritus Scientist	Designation	I.D. Number	Date of Joining	Tenure Upto
1	Dr. Anil K. Ghosh	Emeritus Scientist, CSIR	5032	02/01/2012	07/31/2016
2	Dr. Alok Kr. Datta	Senior Scientist, INSA	5054	05/02/2012	04/30/2017
3	Dr. A.K. Giri	Emeritus Scientist, CSIR	5021	02/07/2012	07/31/2017
4	Dr. N.B. Mondal	Emeritus Scientist, CSIR	5028	05/01/2013	04/30/2017
5	Dr. Syamal Kr. Dana	Emeritus Scientist, CSIR	5029	13/05/2013	05/31/2016
6	Dr. Nanda Ghoshal	Emeritus Scientist, CSIR	5031	08/01/2013	04/30/2017
7	Dr. Keya Chaudhuri	Emeritus Scientist, CSIR	5036	03/02/2014	01/31/2017
8	Dr. A.K. Sen	Emeritus Scientist, CSIR	5038	05/01/2014	12/31/2017
9	Dr. Pijush K. Das	Senior Scientist, NASI	5056	01/01/2015	12/31/2017
10	Prof. Chitra Mandal	Distinguished Biotechnology Research-Professor	5068	04/01/2016	03/31/2019
11	Dr. Samit Adhya	Emeritus Scientist	5067	04/01/2016	03/31/2018
12	Dr. Nahid Ali	Emeritus Scientist	5074	12/01/2016	11/30/2019
13	Dr. H.K. Majumder *	Raja Ramanna Fellow (DAE)	5075	02/27/2017	02/26/2018
14	Dr. Md. Wasim Khan	Senior Scientist NASI	5018	09/09/2012	09/08/2017
15	Dr. Smrutisanjita Behera	Inspire Faculty, DST	5069	03/28/2016	03/27/2021
16	Dr. Sandip Paul	Inspire Faculty, DST Ramanujan Fellow	5073	05/02/2016	05/1/2021

* Dr. H.K. Majumder worked as Raja Ramanna Fellow (DAE) w.e.f. 11.01.2012 to 31.10.2016

RETIREES

Dr. S.N. Kabir
Chief Scientist
31.03.2016

Dr. Sumantra Das
Chief Scientist
30.06.2016

Dr. Nahid Ali
Chief Scientist
31.07.2016

Sri P.K. Chanda
Sr. Tech(1)
31.08.2016

Sri Dipak Kr. Guin
Sr. Stenographer(ACP)
30.09.2016

Sri Asim Roy
Sr. Stenographer
31.11.2016

Smt. Gita Ghosh
GR-C(NT)
31.12.2016

Dr. Chitra Dutta
Chief Scientist
31.01.2017

Sri A.K. Chandra
Astt (F& A) Gr.I
31.01.2017

Dr. Debashish Bhattacharya
Chief Scientist
28.02.2017

Sri Prahlad Das
Lab Assistant
31.03.2017

Smt. Anjana Mandi
Asst (G) Gr.I
31.03.2017

NEW APPOINTMENTS

Shri Sounak Bhattacharya
Technical Officer
30.06.2016

Dr. G. Senthil Kumar
Scientist
18.11.2016

Shri S. Halder
Administrative officer
02.12.2016

TRANSFERRED

Sri Siddhartha Dey
S. O. (G)
30.09.2016

Sri Bishnu Charan Sahoo
A.O
02.12.2016

Mr. Anil Kumar
Scientist
07.04.2017

EVENTS

April 2, 2016	60th CSIR-IICB Foundation Day was celebrated at CSIR-IICB Jadavpur Campus
June 3, 2016	CSIR-IICB Organizes 2nd B.K. Bachhawat Memorial Lecture and Symposium on Chemical Biology Research at CSIR-IICB Jadavpur Campus .The event was organized by the B.K. Bachhawat Memorial Lecture Organization Committee and Chemical Biology Society, India at the Dr. J.C. Ray Auditorium of CSIR-IICB.
September 14, 2016	Hindi week was observed from 7th -14th September, 2016 with great enthusiasm and Sanjivani Patrika 2015-2016 was released on 14th September on Hindi Day which contains several Non scientific articles & Scientific articles in popular language by CSIR-IICB Staff.
September 16, 2016	2nd Annual Students Research Festival organized by CSIR-IICB at Jadavpur Campus
September 19-20, 2016	CSIR-IICB organised an IndoBrazil Symposium on “Biochemistry of Kinetoplastid Parasites” during September 19-20, 2016. Dr. Chitra Dutta, Chief Scientist and Acting Director, CSIR-IICB, welcomed both the Brazilian and Indian Scientists. The main purpose of the symposium was to have an in-depth discussion on different aspects of research being carried out in the two countries.
September 23, 2016	OPEN HOUSE was organized on Saturday, 23rd September, 2016 at CSIR-IICB. One hundred and thirty six, Students from different schools and colleges of Kolkata participated in one day scientific exposure trip to various laboratories and other scientific facilities of the institute
September 27, 2016	Indian Association of Cancer Research (IACR), WB Chapter in association with CSIR-IICB has organize a seminar on September 27, 2016 at Dr. J.C Ray Auditorium, CSIR-Indian Institute of Chemical Biology, Kolkata .There were two lectures on recen.t advances on clinical and basic research on Cancer followed by a short panel discussion. At the end a 'very special' cultural program was presented by the little kids of Thakurpukur Cancer Hospital.
September 28, 2016	CSIR-IICB, Kolkata, observed the 75rd Foundation Day of CSIR on Saturday, September 28, 2016 at Dr. J.C. Ray Memorial Auditorium of the institute. Dr. Samit Chattopadhyay, Director, CSIR-IICB presided over the function in which
October 21 , 2016	Parliamentary Committee on S&T visited CSIR-IICB at Jadavpur Campus
November 23, 2016	India International Science Festival(IISF) Curtain Raiser, OUTREACH Programme organized by CSIR-IICB at Jadavpur Campus
December 18 -20, 2016	3rd International Meet on Advanced Studies in Cell Signaling Network (CeSiN-2016) organized by CSIR-IICB at Jadavpur Campus.
December 22, 2016	26th Annual General Meeting of West Bengal Academy of Science and Technology was jointly organized by West Bengal Academy of Science and Technology & CSIR-IICB at CSIR-IICB Jadavpur Campus
January 10, 2017	Lal Bahadur Shastri National Academy of Administrative (LBSNA), the pioneer training institute for civil servants has chosen CSIR-IICB, Kolkata for a Winter Study Visit organized for Officers Trainees 2016 batch. CSIR-IICB, Kolkata is a pioneer institute under the aegis of Ministry of Science & Technology, Government of India. The institute is engaged in research and development in the field of bio-medical research. CSIR-IICB is welcomed a batch of 18 IAS Officers Trainees on Tuesday, January 10, 2017 for Winter Study Tour.
January 20, 2017	15 students along with faculty of B.Sc 6th Sementer Zoology Pass from Gurucharan College, Silchar, Assam visited CSIR-IICB Jadavpur Campus for one day scientific exposure trip.

January 24, 2017	16 students along with faculty from M. Sc Chemistry, Dept of Chemistry, Mizoram University visited CSIR-IICB Jadavpur Campus for one day scientific exposure trip.
January 26, 2017	68th Republic Day was observed with great show of strength.
March 3-5, 2017	National Symposium on 'Plant Biotechnology: Current Perspectives on Medicinal and Crop Plants' and the 38th Annual Meeting of Plant Tissue Culture Association (India) was held from March 3rd - 5th, 2017 at CSIR-Indian Institute of Chemical Biology, Kolkata
March 8, 2017	20 students along with faculty from M.Sc Agriculture Biotechnology, integrated Rural Development & Management (IRDM) Ramkrishna Mission Ashram, Narendrapur, visited CSIR-IICB Jadavpur Campus
March 10, 2017	12 students of B.Sc 3rd year Physiology (Hons) along with faculty from, Tammralipta Mahavidyalaya, Tamluk, Purba Medinipur visited CSIR-IICB Jadavpur Campus for one day scientific exposure trip
March 27, 2017	18 students along with faculty from M.Sc 4th Semester, Dept of Zoology, Serampore College visited CSIR-IICB Jadavpur Campus for one day scientific exposure trip

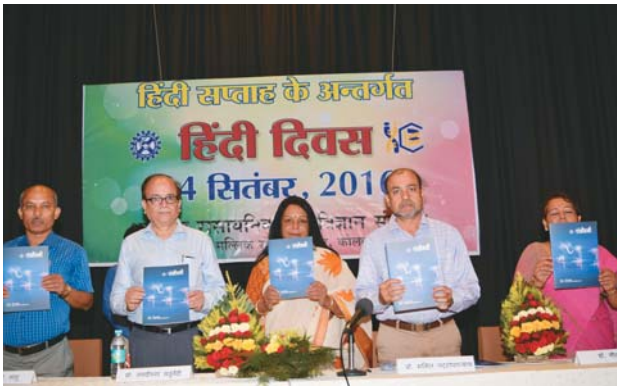
Parliamentary Standing comittee visit, October 21, 2016

PTCA March 3-5, 2017

60th CSIR -IICB Foundation Day April 2, 2016

Independence Day 2016

Hindi Diwas September 14, 2016

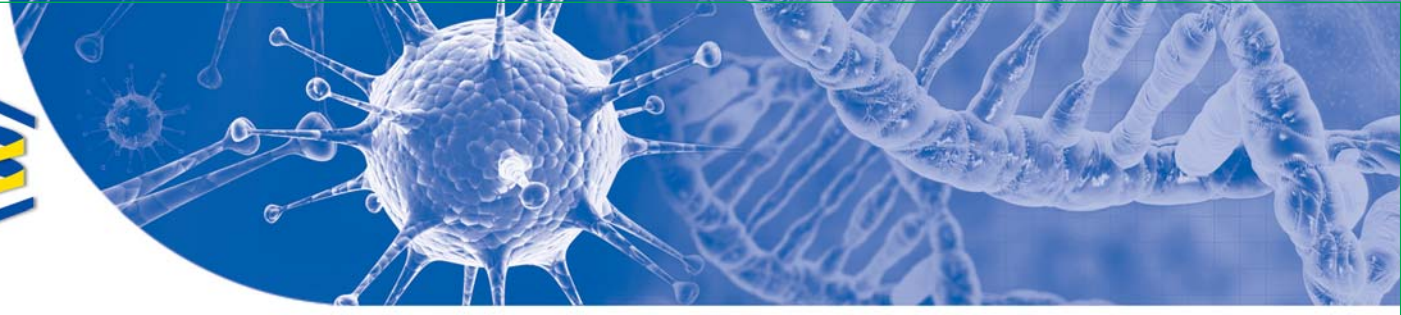


Indo Brazil Symposium September 19-20, 2016

74th CSIR Foundation Day Celebration September 28, 2016

OUT REACH Programme November 23, 2016

3rd International Meet on Advanced Studies in Cell Signaling Network, December 18-20, 2016



IICB Research Council Members

Prof. M. Vijayaan
Chairman (August 2013 - August 2015)
INSA Albert Einstein Professor
Molecular Biophysics Unit
Indian Institute of Seience
Bengaluru - 560012

Dr. Kanury V.S. Rao
Chairman (September 2015 onwards)
Group Leader
ICGEB laborotories, ICGEB campus
Aruna Asaf Ali Marg
New Delhi - 110067

Prof. Subrata Sinha
External expert
Director
National Brain Research Centre (NBRC)
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Haryana - 122051

Dr. Mammen Chandy
External expert
Director
Tata Medical Centre
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Kolkata - 700156

Dr. G.V.M. Sharma
External expert
Chief Scientist
CSIR- Indian Institute Of Chemical Technology
Hyderabad - 500607

Prof. D.J. Chattopadhya
External expert
Pro - Vice - Chancellor (Adademic Affair)
Department Of Biotechnology
B C Guha Centre for Biotechnology and Genetic Engeneering
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Kolkata - 700019

Prof. Rentala Madhubala
External expert
Director, AIRF
School of Life Sciences
Jawaharlal Nehru University
New Delhi - 110067

Dr. Ram A. Vishwakarma
Director
CSIR - Indian Institute of Integrative Medicine
Jammu - 180001
Cluster Director

Dr. T.S. Balganesh
CSIR Distinguished Scientist
CSIR Fourth Papradigm Institute
NAL Balur Campus
Bengaluru - 560037

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Adviser
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New Delhi - 110007

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D.G Nominee
CSIR - Centre for Cellular and Molecular Biology
Hyderabad - 500007
Director
CSIR - Indian Institute of Chemical Biology
4 Raja S.C Mullick Road
Kolkata - 700032

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Head
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Council of Scientific and Industial Research
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New Delhi - 110001

Prof. Umesh Varshaney
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Dept. of Micro Biology and Cell biology
Indian Institute of Science
Bengaluru - 560012

Prof. Amitabha Chattopadhyay
Special Invitee
Out Standing Scientist
CSIR - Centre for Cellular and Cell Biology
Uppal Road
Hyderabad - 500007

MANAGEMENT COUNCIL

(For the period from 01.01.2016 to 31.12.2017)

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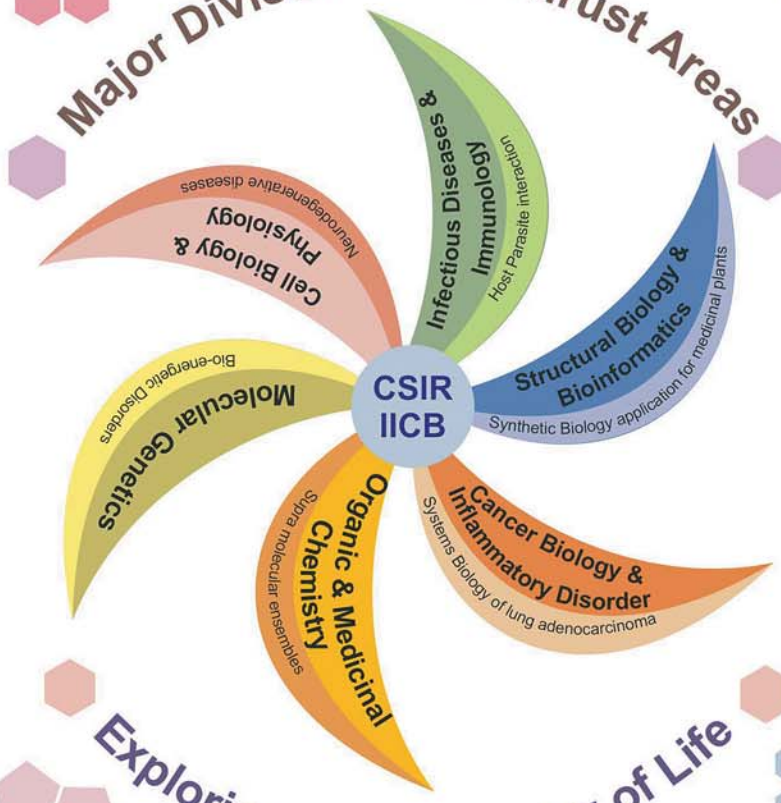
Dr. Ayyappanpillai Ajayaghosh, Director, CSIR- NIIST, Thiruvananthapuram	Member
Dr. G. Suresh Kumar, Chief Scientist and Head PME, P&I and BDG, CSIR-IICB	Member
Dr. Arun Bandyopadhyay, Sr. Principal Scientist	Member
Dr. Sucheta Tripathy, Principal Scientist	Member
Dr. Subhajit Biswas, Senior Scientist	Member
Mr. Anil Kumar, Scientist (upto 07.04.2017)	Member
Dr. Shiddhartha Majumdar, Principal Technical Officer	Member
Mr. Sudipto Chatterjee, F&AO	Member
Mr. B.C. Sahoo, Administrative Officer, (upto 02.12.2016)	Member Secretary
Mr. S. Halder (w.e.f. 02.12.2016)	Member Secretary

CSIR-INDIAN INSTITUTE OF CHEMICAL BIOLOGY

The Institute was established in 1935 as the Indian Institute of Medical Research and became a unit of CSIR in 1956. It owed its origin to the inspiration of prominent personalities like Gurudev Rabindranath Tagore, Acharya Prafulla Chandra Roy, Pandit Jawaharlal Nehru and many others. Today, by its mandate CSIR-IICB is engaged in research on diseases and certain biological problems of global interest.

Major Divisions and Thrust Areas



Exploring the Chemistry of Life

Generating Knowledge Globally
- ❖Publishing Papers/ Year > 185
- ❖Average Impact Factor > 3.3

Transforming Knowledge into Wealth (IP)
- ❖Filing Patents/Year > 8
- ❖Patents Granted/Year > 4

Potential Technologies Developed Recently
- ❖Biomarker for valvular heart disease
- ❖Microbicidal Contraceptive to Prevent HIV
- ❖Gene Therapy for Mitochondrial Diseases
- ❖Visceral Leishmaniasis Detection Kit
- ❖Anti-leishmanial Drug Candidates
- ❖Anti-asthmatic Drug Candidates
- ❖DNA Vaccine against Kala-Azar
- ❖Anti-cancer Drug Candidates
- ❖Anti-ulcer Drug Candidates

A symbiosis between chemistry and biology that translates to a commitment to higher standards of health for all.
Institute-Industry tie up recently rolled out PROSTALYN - a herbal composition for Prostate diseases.
Other products or processes accepted by industries for marketing: a herbal composition against chronic myeloid leukemia (CML), a potent DNA vaccine against Kala-azar, a diagnostic technology to detect a protein associated with pregnancy and embryo, a herbal extract & composition for peptic ulcer diseases.

Building People and Institution
Initiated and nurtures NIPER, Kolkata (National Institute of Pharmaceutical Education and Research); PhD Registration under AcSIR; Three schools adopted & receives laboratory aids.

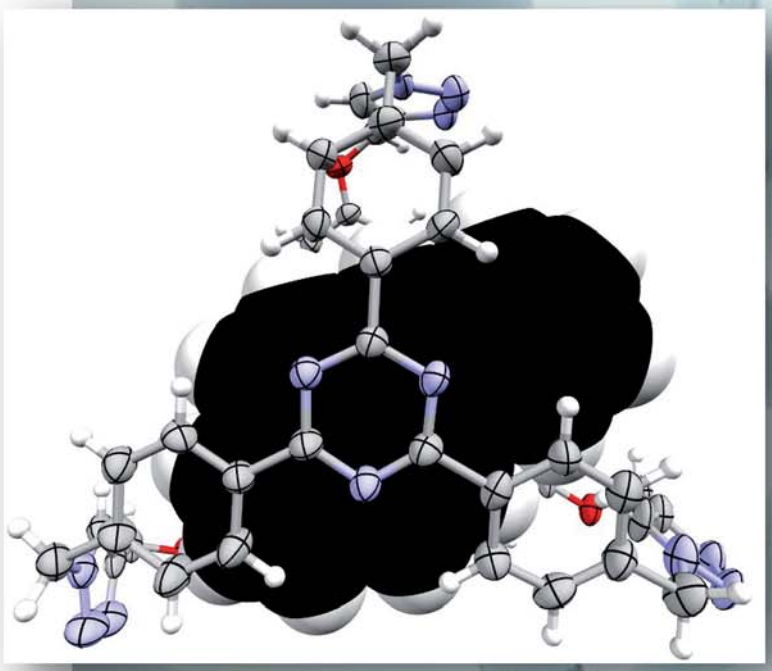
Infrastructures to be operationalized
Salt Lake Campus; New Laboratory Building, Jadavpur Campus;
CSIR Innovation Complex, Baruipur, South 24-Parganas


CSIR-IICB, Salt Lake Campus

Major Facilities Available
- State of the art Instrumental facilities
- Modern Animal House
- Modern Library Computer Division

Contact:
Director, CSIR-IICB
Phone: +91 33 2473 0492; Fax: +91 33 2473 5197, +91 33 2472 3967
E-mail : director@iicb.res.in

4, Raja S.C. Mullick Road, Kolkata-700 032, West Bengal, India
Website: www.iicb.res.in



x-ray Structure of the organic cage inticrated within polycylic arromatic hydro carbon guest

Courtesy :
Dr. Ramalingam Natarajan

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Mr. Arupesh Majumdar (Member)
Mr. Sudipto Chatterjee (Member)
Mr. Suprakash Halder (Member)
Mr. Anjani Kumar Pandey (Member)
Mrs. Ambalika Nag (Member)
Mr. Sankar Bhakta (Secretarial Assistance)

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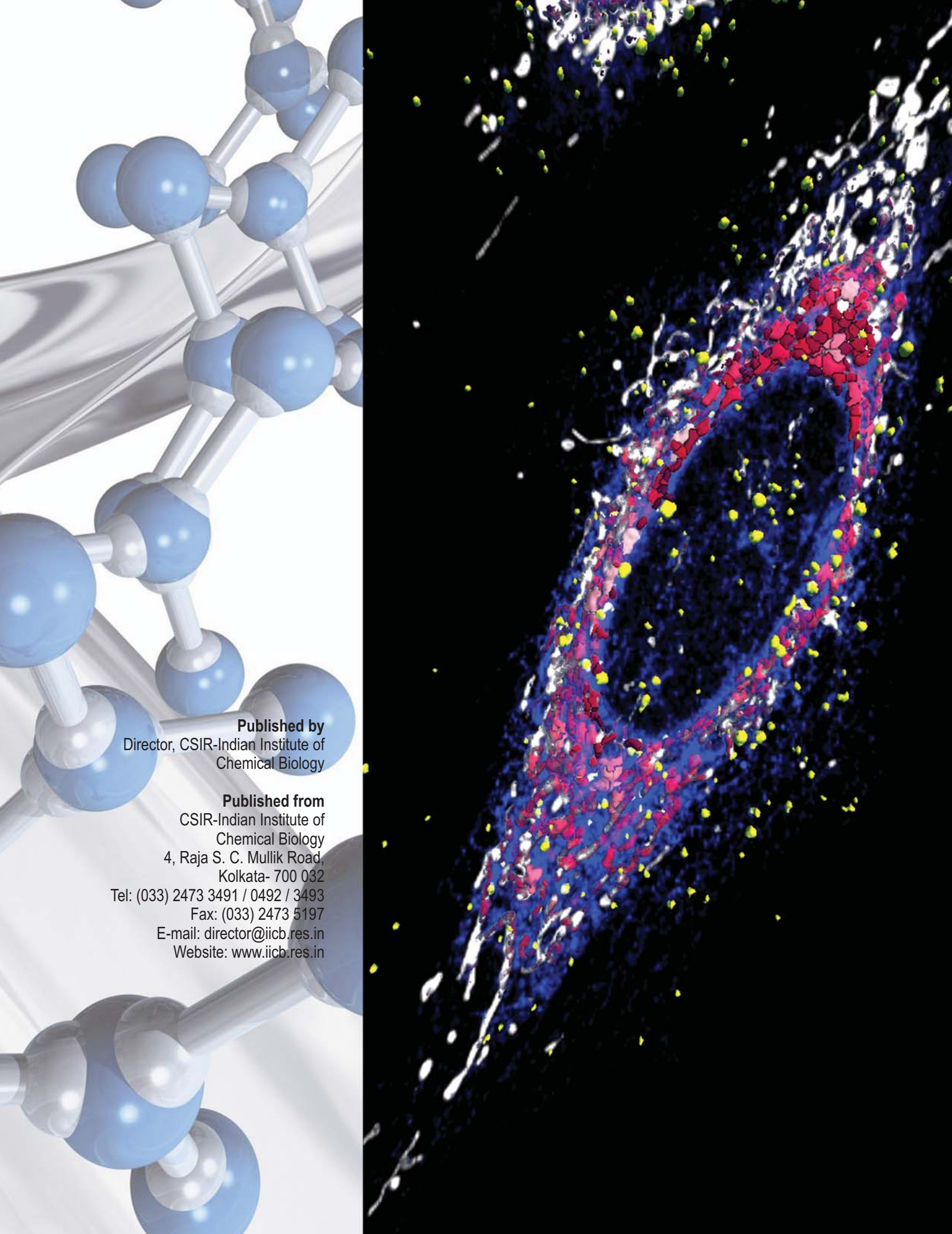

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